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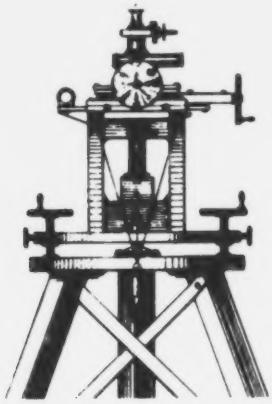
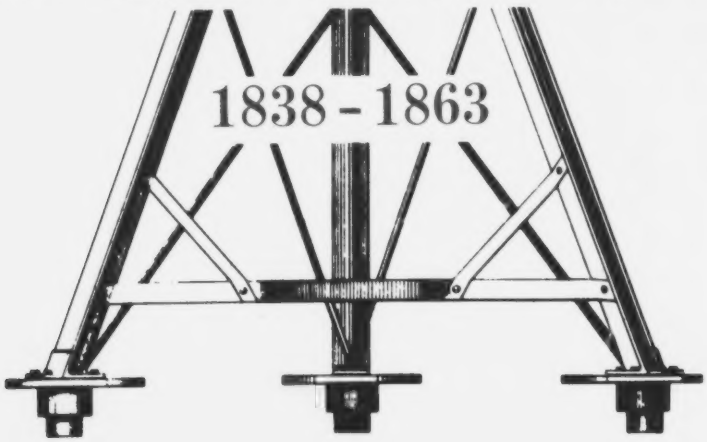
The Nation Builders



A Sesquicentennial History of the Corps of Topographical Engineers



Frank N. Schubert, Editor

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THE NATION BUILDERS

A SESQUICENTENNIAL HISTORY OF THE CORPS OF TOPOGRAPHICAL ENGINEERS 1838–1863

Frank N. Schubert
Editor

OFFICE OF HISTORY
UNITED STATES ARMY CORPS OF ENGINEERS
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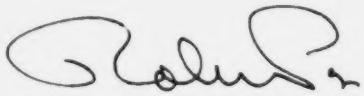
Foreword

This book marks an important anniversary in the history of our development as a nation. In 1838 Congress established the Corps of Topographical Engineers, an organization whose main purpose was the peacetime fostering of economic growth and national cohesion. This small dedicated group of officers contributed to the development of many aspects of the national transportation network—railroads, highways, and inland waterways. They provided maps for overland travelers and charts for navigators on our Great Lakes. By the time that the organization was abolished during the Civil War, it had played a major part in a period of dramatic development aptly characterized by one historian as a "transportation revolution."



ROBERT W. PAGE
Assistant Secretary of the Army
(Civil Works)

Note on Authorship and Documentation

This book is the product of the efforts of a number of historians on the staff of the Office of History. Martin Reuss drafted the sections dealing with rivers and harbors and related matters. Dale E. Floyd contributed the portions on the Seminole and Civil Wars and much of the material concerning construction. Martin K. Gordon provided material on the topographers in the District of Columbia. Frank N. Schubert wrote most of the rest of the original text and served as editor for the project. Critiques of the completed draft as compiled by the editor were provided by Reuss, Floyd, Charles Hendricks, Paul K. Walker, and John T. Greenwood.

Footnotes have been used in the text only to identify material quoted directly from the works of other authors. A fully documented version of the manuscript is on file in the Office of History.

Preface

One hundred and fifty years ago, Congress created a small organization that filled a big need. The Corps of Topographical Engineers existed only briefly in our history, from 1838 to 1863. However, this handful of dedicated officers proved a major force in the development of the nation.

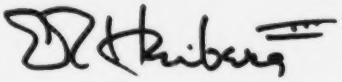
Army topographers were at the center of an energetic and expansive period of development. In the years between the War of 1812 and the Civil War, Americans fanned out from the original seaboard states, west to the Mississippi River and beyond to the Pacific Ocean. The topographers did much to encourage this process and the economic growth that went with it. They explored and mapped regions beyond the frontier, laid out roads and railroad routes, and supervised the rivers and harbors work that evolved into the modern civil works program of the Corps of Engineers. Truly, they were nation builders.

They set numerous precedents for the Engineers of the 20th century. In addition to their rivers and harbors work, they carried out construction projects and surveys for other government agencies. They also became involved in the construction of public facilities in the nation's capital, another long-standing Engineer job that lasted far into the current century.

For all of their contributions to the development of civil society, they were soldiers too. Their wartime service ranged from reconnaissance of enemy lines to publication of maps. Like their counterparts in the Corps of Engineers, they combined civil and military responsibilities within the same engineering organization in a distinctly American way.

This small volume pulls together for the first time the story of their accomplishments, both military and civil. It should have

a special appeal to people associated with the Corps of Engineers as well as others interested in the development of the nation and the modern Corps of Engineers.



E. R. HEIBERG III
Lieutenant General, USA
Chief of Engineers

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THE NATION BUILDERS

A SESQUICENTENNIAL HISTORY OF THE CORPS OF TOPOGRAPHICAL ENGINEERS 1838–1863

CHAPTER I

Origins

Geographers

Early in the War of Independence, the Army realized that it needed specially trained officers for topographical duty. General George Washington faced a compelling need for technical help in reconnaissance. He particularly wanted men to map "Roads, rivers, Bridges, and Fords over them, the mountains and passes through them." This need forced him to seek creation of a geographer's department to supplement the work of his engineers. As usual, Washington had to prod Congress into action. In July 1777 the legislators finally approved his proposal for appointment of a geographer "to take sketches of the country, the seat of war, and to have the procuring, governing, and paying the guides employed under him."

Washington appointed Robert Erskine, a mapmaker, inventor, and member of the Royal Society of London. The choice was a good one. With his assistants and chain bearers, Erskine prepared numerous valuable sketches before his sudden death in October 1780. His 24-year-old assistant, Simeon DeWitt, carried on the work, aided after May 1781 by Captain Thomas Hutchins, who filled the position of "geographer to the southern army." DeWitt remained "geographer to the main army" until Congress changed the titles of both men to "geographer of the United States" by a resolution of 11 July 1781. During that year, they provided invaluable aid to the Army in the Yorktown campaign. After the war, Congress drastically reduced the size of the Army and abolished the geographer positions. DeWitt became surveyor general of the state of New York; Hutchins stayed with the Army to direct the surveys of the Northwest Territories.

Topographical Engineers

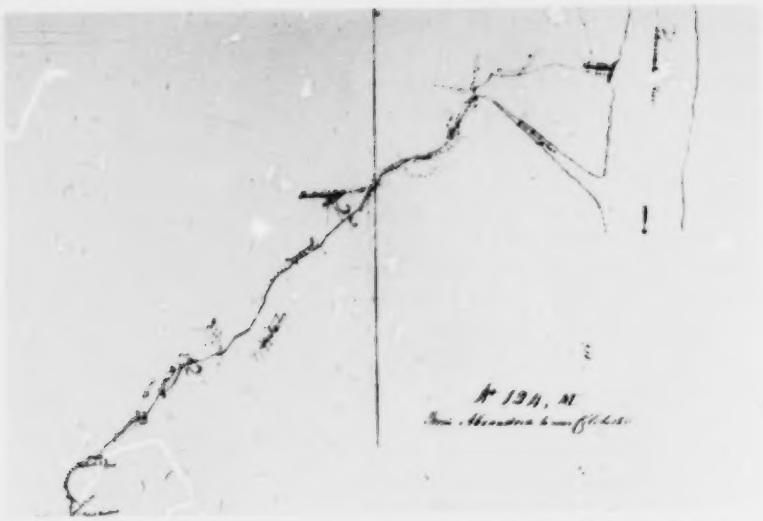
Thirty years passed before officers with comparable talents served in the Army. In fact, no engineers of any sort were accepted

Geographer Robert Erskine (1735–1780), assisted by William Scull, prepared this survey of New York and Connecticut in 1778. The map shows surveyed and unsurveyed roads, footpaths, commanding heights, and taverns. General Washington used this map in planning troop movements around New York City.

in service until war with Britain threatened in 1794. At that time engineers and artillerists were merged into a single corps. They were separated in 1802 with the establishment of the Corps of Engineers, which included no topographical officers.

When the War of 1812 began, the Army again faced the need for topographical services. Congress responded somewhat more generously than it had in 1777. The act of 2 March 1813 authorized eight Topographical Engineers and eight assistants. However, the topographers were not organized into a corps or provided with any administrative machinery. They were simply attached to the general staff of the Army. Major and later Lieutenant Colonel John Anderson of Vermont was the senior topographer.

The immediate postwar period resembled the situation after the Revolution. In effect, the act of 3 March 1815 abolished the Topographical Engineers. That law specified the entire military establishment, including engineers, but made no mention of topographers. All of the Topographical Engineers received honorable discharges from the Army on 15 June 1815.



The geographer's department under Erskine's successor, Simeon DeWitt (1756–1834), prepared this map of the route from Alexandria, Virginia, crossing Great Hunting Creek and skirting Washington's home at Mount Vernon, to a point near Colchester. One of a series, the map helped guide the armies of Washington and Rochambeau to Yorktown in 1781.

In spite of the 1815 housecleaning, some continuity was maintained. Two of the topographers, Majors Anderson and Isaac Roberdeau, were kept on active duty to complete surveys of the northern frontier and Lake Champlain. They were still at work when the act of 24 April 1816 was passed. The act restored three Topographical Engineers with the rank of major to the general staff of each of the two divisions of the peacetime establishment and an assistant topographer with the rank of captain to all four brigades of the Army. This was a major piece of legislation for the topographers, perhaps the most important one between 1813 and 1838. For the first time, the peacetime army provided a place for military topographers. Like its predecessors, this act also fell short of providing a corps for the topographers or any centralized administrative machinery.

The 1816 act recognized that topographical expertise was essential to successful military operations. Yet such skills also were important for a wide variety of engineering projects that may have enhanced military preparedness but were also valuable for the commercial expansion of the country. For instance,

when Major Stephen H. Long explored the upper Mississippi River in 1817, he was as interested in conveying his ideas about potential river and road improvements as he was in advising his superiors about the best locations for fortifications. Other Topographical Engineers helped survey the nation's coastline. Proper surveys were necessary not only for constructing fortifications, but also for improving navigation.

An 1816 report on national defense by the newly established Board of Engineers for Fortifications clarified the relationship between national defense and commercial expansion. Three Army Engineers—Brigadier General Simon Bernard (recently arrived from France), Captain Joseph G. Totten, and Major William McRee—and a senior naval officer concluded that national defense rested on four pillars. These were a strong navy, coastal fortifications, a regular army, and good transportation facilities through the country's interior. As to the last point, the authors noted that good lines of communication helped "to develop the agricultural industry of the country, the fundamental basis of public prosperity, and to consolidate the internal peace of the citizen." Secretary of War John C. Calhoun agreed with these conclusions and in 1819 recommended federal help to improve transportation routes, including waterways.

Assignment to the Engineer Department

While this understanding concerning the relationship between military and civil engineering works emerged, the War Department consolidated its engineering talent. On 2 July 1818, the department placed the topographers in the Engineer Department, along with the Corps of Engineers, the U.S. Military Academy, and the Board of Engineers for Fortifications. This action created a total authorized labor pool of 32 men: 10 topographers and 22 officers of the Corps of Engineers. One month later, the Engineer Department placed Major Roberdeau in charge of the newly established Topographical Bureau. This bureau served merely as a depot for instruments, reports, memoirs, and publications. It managed no programs and controlled no personnel. In short, it was a depository, not an administrative entity.

Placement of the Topographical Engineers under the Engineer Department confirmed the close but sometimes strained

Major Isaac Roberdeau (1753–1829) was the first chief of the Topographical Bureau. A practicing civil engineer for many years, he sought for some time to join the Army "with a rank suited either to my support or capacity." The opportunity finally came during the War of 1812. He entered the service as a major of Topographical Engineers in 1813 at the age of 40. After the war, he carried out the survey of the 900-mile segment of the border with Canada that ran from the St. Lawrence River west and north to the falls of St. Mary's River between Lakes Superior and Huron.

relationship that had developed between the topographers and Engineers over the previous two years while working on related or identical projects. While officers of the Corps of Engineers thought of themselves chiefly as fortifications engineers, they too became involved in surveys relating to internal improvements. Thus, while Major Long, a Topographical Engineer, led the 1819 expedition to the trans-Mississippi West, General Bernard and Major Joseph G. Totten, both assigned to the Corps of Engineers, conducted the survey of the lower Mississippi. This pattern of using both topographical and fortifications officers continued in the next several years on the few harbor projects approved by Congress.

The partnership between officers of the Corps of Engineers and the topographers was uneasy. Indeed, the competition for work and influence between the Engineer and topographical officers resulted in substantial bitterness and tension. The antagonism originated in the frustrations that the Topographical Engineers had experienced since at least 1816, when Congress had refused to establish a separate Corps of Topographical Engineers and had authorized only the creation of peacetime Topographical Engineer positions. This disappointment would not have rankled so much if, in 1818, Corps of Engineers officers had accepted the topographers as equals rather than as subor-

dinate functionaries. Instead, the topographers were patronized and isolated. One reason for the animosity was that regular Corps officers were chosen from the top ranks of graduating West Point classes; Topographical Engineers were chosen from the second rank. As West Point graduate and artillery officer John Tidball later explained, it was "a kind of fixture in our minds that the engineers were a species of gods, next to which came the 'topogs'—only a grade below the first, but still a grade—they were but demigods."[1]

Experience as well as class standing separated the topogs from the regular Engineer officers. According to Totten, the topographers were "not engineers in the sense in which officers of the Corps of Engineers are—any more than the officers of ordnance, artillery, cavalry, riflemen, or infantry are engineers." He claimed that he had the "highest respect" for the topographers and believed that "a more excellent body of officers is no where to be found," but greater skills were necessary to plan and construct fortifications than for civil works. The topogs were just not up to the job. "We see," Totten said, "no where among them any, *not a single individual*, . . . whom we could see introduced into the Corps of Engineers without mortification or pain."

Officers of the Corps of Engineers ran the Engineer Department, and they made sure that management stayed within the immediate family. Colonel Walker K. Armistead, who was Chief Engineer from 1818 to 1821, bypassed Major Roberdeau, the senior topographical officer, to appoint a captain and sometimes even a lieutenant of the Corps of Engineers to take over the department in his absence. His successors, Colonels Alexander Macomb and Charles Gratiot, continued this practice. So correspondence between the War Department and the topogs passed through a junior officer of the Corps of Engineers, Roberdeau remained an administrative nonentity, and the topogs were plainly second-class citizens in the department.

By 1824 the antagonism between topographical and Engineer officers was evident. Major Long thought the Engineer officers "cordially hate us or more probably are jealous of our rising reputation." Frustrated by the lack of recognition and professional respect, the topographers yearned to prove them-

[1] James L. Morrison, Jr., *"The Best School in the World": West Point, the Pre-Civil War Years, 1833–1866* (Kent, OH: Kent State University Press, 1986), p. 142.

selves. So it was a crushing disappointment when President James Monroe did not name one of them to the new Board of Engineers for Internal Improvements. "Is it honorable to our corps that we are always to remain mere beasts of burden," Long asked Roberdeau. "Are we incompetent to express our judgment, or to give an opinion in matters of professional duty. . . . Are we to be mere chain bearers in the giant work of internal improvement. . . . [Are civilians] to be placed over us as directing engineers, while we are to be mere drudges."

The General Survey Act and the Board of Engineers for Internal Improvements

By 1824 the importance of waterways in the young nation was clear. Rivers were the paths of commerce. They provided routes from western farms to eastern markets. They promised a new life to the seaboard emigrant and financial reward for the Mississippi Valley merchant. Without its great rivers, the vast and thickly forested region west of the Appalachians would have remained impenetrable to all but the most resourceful. But the rivers that beckoned also could destroy the dreams of unwary travelers and shippers whose boats were punctured by snags or stuck on sandbars. Both commercial development and national defense, as shown during the War of 1812, required more reliable transportation arteries. The solution was obvious but difficult: out of those unruly streams engineers had to carve navigation passages and harbors for a growing nation.

In the years before 1824, federal assistance for "internal improvements" evolved slowly and haphazardly, the product of contentious congressional factions and an executive branch that was careful to avoid unconstitutional federal intrusions into state affairs. In 1802 Congress began the practice of appropriating money for specific internal improvements when it authorized a maximum of $30,000 for the construction and repair of piers in the Delaware River. Seven years later, Congress appropriated $25,000 to lengthen the Carondelet Canal and to deepen the Mississippi channel at New Orleans. Although by the War of 1812 there was wide agreement that the government would have to guide and assist in public improvements, the war itself temporarily halted improvement programs. The federal government did not authorize money again until 1819, when it appropriated $6,500 for a survey of the tributaries of the Mississippi

Stephen Harriman Long (1784–1864) graduated from Dartmouth College in 1809. Following a short teaching career, in 1814 he joined the Corps of Engineers as a second lieutenant. He became a Topographical Engineer in 1816. For two years he served as assistant professor of mathematics at West Point. Thereafter he had a wide-ranging career as an explorer, railroad and river engineer, and inventor. His explorations included the upper Mississippi River and its tributaries; the Missouri, Platte, and South Platte; and the eastern range of the Rocky Mountains in Colorado as well as a considerable part of the Arkansas River basin. In the late 1820s, after his important work on the Ohio River, he was assigned by the Department of

and Ohio rivers. In the early 1820s, more money was appropriated for such projects as a survey of the lower Mississippi, seawall and lighthouse construction on the Maine–New Hampshire coast, removing obstacles in Gloucester Harbor, and a harbor survey at Presque Isle, Pennsylvania. This federal assistance was a pittance, however, totaling no more than about $85,000 between 1802 and 1823.

But in the end money was not the most important form of federal assistance. Indeed, state treasuries and private subscriptions provided most of the funding for the nation's early road and canal expansion. Nevertheless, the federal government rendered one service that was critical to any national program of internal improvements. It provided a body of well-trained engineers dedicated to public service. For a generation after the War of 1812, Army topographers and fortifications engineers designed and constructed numerous national defense and transportation projects. But in the great work of internal improvements, the contribution of the Topographical Engineers was particularly impressive.

Support for an increased government commitment to internal improvements grew gradually after the War of 1812. Each President asked Congress to provide for a federal system of roads and canals and for increased support of the engineering

War to serve as consulting engineer for the Baltimore and Ohio Railroad Company. He soon came to be regarded as an expert in railroad engineering, although friction with the B&O management resulted in his severing ties with the company in 1830. His *Rail Road Manual* (1829) presented tables that eliminated the need for field computations. Later, he surveyed various railroad routes in Georgia and Tennessee and became the chief engineer for the Atlantic & Great Western Railroad. He also served as consulting engineer for a number of other railroad companies. His experience led him to develop a new method of bracing and counterbracing wooden bridges, and the Long truss bridges became popular throughout New England and elsewhere. In the 1840s and 1850s, Long served as Superintendent of Western Rivers, with the responsibility for ensuring the navigability of the Mississippi and Ohio river systems.

branches of the War Department. Secretary of War Calhoun's 1819 "Report on Roads and Canals" also advocated extensive use of the Army's topographers and fortifications engineers for surveys of these public works. In 1822 Major Roberdeau urged civil functions for Army Engineers, proposing a large corps of Topographical Engineers to develop engineering science for the combined benefit of public improvement and military defense. He cited the lack of civil engineers, the demand for internal improvements, and the military and civil uses of surveys, as well as a need for government encouragement to civil engineering. During the following year, General Bernard also voiced support for a large topographical corps with broad civil functions.

At the same time, western congressmen reminded their legislative colleagues of the importance of internal improvements. There was ample documentation of the need, including Secretary of the Treasury Albert Gallatin's famous 1808 report recommending the construction of various public roads and canals to connect the eastern seaboard with the Ohio and Mississippi valleys. One eastern supporter, Congressman Joseph Hemphill of Pennsylvania, introduced legislation in 1822 to authorize various surveys of proposed transportation improvements. However, Congress did not act on the bill either that year or the next. In 1823 President Monroe recommended that Army

Engineers survey the proposed Chesapeake and Ohio Canal, a project that he thought of great military and commercial value. The President's notion of using Army Engineers dovetailed with a second report submitted by Hemphill, in which he stressed that employing Army Engineers on surveys would "give them experience, and advance their usefulness to their country." Finally, in 1824, led by the redoubtable Henry Clay of Kentucky, proponents of internal improvements had their day. On 30 April 1824, the General Survey Act became law.

The legislation sought "to procure the necessary surveys, plans, and estimates upon the subject of roads and canals." It was a modest act, befitting an administration and Congress generally willing to support legislation that promised much but committed very little federal money. It authorized the President to have "surveys, plans, and estimates" made of road and canal routes (but not rivers) that he deemed of national importance for commercial, military, or postal service purposes. To carry out the surveys, the President was authorized to hire two or more skillful civil engineers and as many officers of the Corps of Engineers as he thought necessary. Congress provided $30,000 to cover expenses. The act portended a great national program of internal improvements, but it was only planning legislation; no money was appropriated for construction. That important step occurred three weeks later.

On 24 May 1824 President Monroe signed a second important bill. This law appropriated $75,000 to improve navigation on the Ohio and Mississippi rivers. The act empowered him to employ "any of the engineers in the public service which he may deem proper" and specifically directed that two experiments be conducted at two different Ohio River sandbars to ascertain the best means of removing bars from that river. To clear the Mississippi, the President was authorized to procure the "requisite water craft, machinery, implements, and force" to eliminate various obstructions. While providing navigation channels on the Ohio and Mississippi rivers was of substantial potential military value, there is little question that this act passed in response to the urging of western politicians who were interested mainly in commercial expansion.

Thus, within one month's time Monroe signed two acts that would have a large impact on the Corps of Engineers and the Topographical Engineers. From that point, both were deeply in-

volved in civil works. When the nation needed engineering talents to design and create internal improvements, it looked to the Army.

At the end of May, Monroe appointed a Board of Engineers for Internal Improvements to administer the General Survey Act. Its members were Chief Engineer Macomb, General Bernard, Major Totten, and civil engineer John L. Sullivan. Although no topogs served on the board, three were attached to it as leaders of the three surveying parties assigned to evaluate possible canal routes. Overall, the President underscored the importance of the new board by assigning experienced and able officers to it. Through the membership of Totten and Bernard, who were also on the Board of Engineers for Fortifications, he also made clear the close relationship between internal improvements and national defense.

Parties known as brigades conducted the surveys under the General Survey Act. In 1830, for example, 13 brigades worked on canal, road, and railroad surveys. Topographers led ten of them; civilians managed the other three. Each brigade had a threefold assignment. It reconnoitered and made a preliminary survey of a potential project. Then it plotted the exact location of the route in question. Finally, it prepared project plans and specifications, including a cost estimate. With only ten Topographical Engineers in the Army, it is easy to see how dramatically this mission changed the work patterns of the topogs. Originally conceived to fill a military need for reconnaissance and maps, the topographers were now deeply involved in national development. They were also well on the way to gaining national fame.

Some controversy centered around who should have the responsibility for the work on the Ohio and Mississippi rivers. Congressman Alexander Smyth of Virginia suggested using the Navy. Reflecting a simplistic, if not simple-minded, view of river improvements, Smyth volunteered the idea that the Navy could build gunboats at Pittsburgh and then send them downstream to New Orleans, presumably obliterating obstructions along the way. Clay and Calhoun supported giving the work to the Army Engineers, who were by far the most experienced and best trained for that responsibility. President Monroe may have been inclined toward the Army Engineers in any case, but the arguments of Calhoun and Clay certainly influenced him, and he directed Macomb to take charge of the river work.

Major Long's 1825 sketch of the wing dam built under his supervision at Henderson Bar, Kentucky. This was the first dam constructed by the federal government and the first in the United States to deepen a channel by increasing the velocity of the current.

While the Engineer Department assumed overall supervision of the surveys and the navigation work on the Mississippi and Ohio rivers, a major portion of the field work fell to the topographers. As it turned out, the enormous amount of work that resulted from the General Survey Act and the great distance separating the survey parties from the Engineer office in Washington necessitated relying on the discretion and competence of the local officers in charge. The animus of fortifications engineers against internal improvements involvement and the nature of much of the work, namely surveying, naturally led to using Topographical Engineers as much as possible, although the Chief Engineer remained in overall charge. By the end of 1824, all ten Topographical Engineers had been assigned to internal improvement projects. The editor of the *National Journal* observed that the Topographical Engineers were no longer being stationed at the entrances to major rivers or along the seacoast as had formerly been the case, but instead were "scattered over the interior of our country, finding the summit levels of our mountains, or tracking the route for vast lines of intercourse through our forests, swamps, and valleys."[2] Al-

[2] Quoted in Garry D. Ryan, "War Department Topographical Bureau, 1831–1863: An Administrative History" (Doctoral dissertation, American University, 1968), pp. 19–20.

though understaffed, the topogs set to work developing a system of internal improvements that eventually evolved into the modern civil works program of the Corps of Engineers.

Canal surveys dominated the work of the Topographical Engineers during the first two years following passage of the General Survey Act. The Board of Engineers for Internal Improvements devised a list of 27 canals that were valuable for both military and commercial purposes and rated them in order of priority. A canal to connect the Delaware and Raritan rivers in New Jersey headed the list. Secretary of War Calhoun emphasized the importance to the nation of linking the Potomac to the Ohio River and Lake Erie, of establishing a waterway along the Atlantic Coast connecting major navigable channels, and of building a road from Washington, D.C., to New Orleans. The work overwhelmed a department that numbered only 32 men.

Initially, Congress must have been reasonably happy with the work of the Engineer Department. In 1826 it passed a law that led to an expanded work load for the department. New legislation authorized the President to make river surveys, to clean out and deepen selected waterways, and to carry out various other rivers and harbors improvements. Although the 1824 act to improve the Mississippi and Ohio rivers is often called the first rivers and harbors legislation, the 1826 act was the first to combine authorizations for surveys and projects, thereby establishing a pattern that continues to the present day.

Before long, the work required by specific pieces of rivers and harbors legislation outstripped surveys under the General Survey Act. During the 14-year life of the General Survey Act, Congress appropriated $424,000 for surveys in accordance with its provisions. On the other hand, rivers and harbors work supervised by the Board of Engineers for Internal Improvements at the behest of Congress totaled $9 million during the same period. Generally, topogs did the surveys; fortifications engineers supervised construction.

To the extent that Congress was indeed satisfied with the work of the military engineers, the topographers deserved much of the credit. Their work in the field showed that experimentation and innovative design were often superior to the narrower theoretical approach taken by some West Point–trained Engineer officers. By September 1825 Stephen Long, working on the Ohio River just below Henderson, Kentucky, had built a wing

dam consisting of two rows of more than 600 wooden piles, driven to a depth of 16 feet. Between the rows, he placed driftwood and other debris and at the base, broken rock and clay. He experimented with the proper angle, width, and length to achieve the greatest velocity of current. Theory and empirical data both showed that the increased velocity should reduce the sandbar and increase the depth of the river. Long extended the dam another 50 feet and angled it out at about a 45-degree angle. This design worked. The depth of water over the bar ranged from four to eight feet, enough for most vessels of the time. The dam served as the prototype for many others along the Ohio River and required no significant repair until 1872.

Long was not completely satisfied with his work. He realized that the dam would not prevent the formation of bars. Each year, the Ohio would push and carry sediment downstream, forming bars at different points, including at the dams themselves. More and more, he turned his thoughts to mechanical means of improving rivers, including the use of dredges and snagboats and even a diving bell for underwater excavation. Such mechanical contrivances were anathema to those who insisted that theory, properly applied, would allow engineers to regulate a river so as to eliminate natural hazards.

Chief Engineer Macomb also refused to be bound by any one approach. He respected the value of a West Point education, though he himself was not one of its products, but he appreciated the importance of practical experience. So he sponsored a contest to fashion a machine that could eliminate obstructions to navigation. The winner would receive $1,000 and a contract to open up the Ohio River. The prize went to John Bruce, who designed a simple device consisting of a double-keeled barge that supported a system of pulleys and levers to extract debris from the river. However, Bruce and Macomb disagreed on the contract terms, and the boats Bruce designed proved to be of limited service. Long suggested that Bruce be replaced by Henry M. Shreve, a man known for his navigation skill on the Mississippi and Ohio rivers and for his pioneering efforts to bring trade and commerce to the Mississippi Valley.

Shreve cared little for hydraulic theory. His attitude was to design whatever it took to get the job done, and he settled on building a revolutionary new boat, a steam-powered snagboat. Put into service in 1829, it became the model for steam snag-

boats on the Ohio, Mississippi, and elsewhere. Like Bruce's boat, it was twin-hulled, joined by an iron beam. Unlike Bruce's effort, however, Shreve's boat ran full-steam into the snags, jarring them loose. The limbs then were hoisted and broken apart on the vessel's deck. "Uncle Sam's Toothpullers," Shreve's snagboats came to be called. They were the product of American ingenuity, unlike anything known elsewhere in the world, and they had a dramatic effect. Insurance and shipping rates dropped, and the number of steamboats increased significantly on the Mississippi and Ohio rivers. By 1834 Engineer Lieutenant Alexander Hamilton Bowman was able to report that "high-water navigation is rendered comparatively safe and easy. Boats run with security at night, where, a few years since, it was hazardous to attempt a passage even in daylight."[3]

The Corps' work on the Mississippi and Ohio rivers was considered of paramount importance by western entrepreneurs, but Engineer projects farther east attracted equal enthusiasm and support. By the end of the 1820s, both topographers and Engineer officers were occupied in improving and surveying rivers and harbors from one end of the country to the other. From 1826 to 1838, annual rivers and harbors acts expanded the number of projects and appropriated more money for ongoing work.

There were never enough Engineer officers of either description to handle the work. Each year many petitions for surveys went unanswered. Congress also turned down pleas for increases in the number of topographers and Engineers from Secretary of War James Barbour in 1825 and from the topographers themselves two years later.

Although additional positions were not approved, the topographers did win representation on the Board of Engineers for Internal Improvements. Major John J. Abert, the senior man after the January 1829 death of Major Roberdeau, was appointed to the board that year. The victory did not amount to much, however, because the board itself was about to be abolished. Its usefulness had diminished once its responsibility for identifying locations for engineering work was completed. Besides, by that time, Congress, rather than the board, was dictating surveying

[3] Quoted in Louis C. Hunter, *Steamboats on the Western Rivers, An Economic and Technological History* (New York: Octagon Books), p. 200.

requirements to the Army. So when General Bernard left the board in August 1831 to return to France, the Board of Engineers for Internal Improvements was terminated.

CHAPTER II

Independence for the Topogs

The Topographical Bureau

When Secretary of War Peter B. Porter abolished the Board of Engineers for Internal Improvements, he elevated the Topographical Bureau to independent status within the War Department and transferred to it the responsibility previously discharged by the board. The Topographical Bureau then became the conduit for channeling engineering assistance to promising improvement projects.

To a large extent, this change represented a victory for Colonel Abert and the topographers. Through the 1820s, their prestige had grown without redounding to the benefit of the bureau. In 1830, as in 1820, it was still the least important unit of the Engineer Department. When Roberdeau died, the bureau was still an instrument depot and repository for maps, charts, and reports. Roberdeau had dutifully made available information for reference, inventoried holdings, ordered and maintained instruments, and purchased map cases and other containers. All in all, he was little more than a supply clerk. In directing the activities of the topogs, the Chief Engineer acted without Roberdeau's advice or consent.

The topogs' future looked bleak at the start of 1829, portending only more dependence on the Engineer Department. Then Roberdeau died. But when Abert took charge, he immediately began a campaign to increase his authority and break free of Engineer control. He had a twofold goal: a bigger, more important bureau independent of the Engineer Department and a separate Corps of Topographical Engineers, free of the Corps of Engineers. As justification for these changes, Abert claimed that the duties of both kinds of engineers—topographers and fortifications engineers—were so important, so extensive, and so distinct that the public interest and the welfare of both corps warranted the division. The Topographical Bureau, Abert con-

tended, should manage its own affairs and report directly to the War Department. The Chief Engineer, Colonel Charles Gratiot, disagreed. He claimed that surveys and construction were inseparable. Secretary Porter sided with Gratiot.

Gratiot did concede to Abert the position of military assistant for topographical matters. He granted Abert authority to issue orders and instructions to topogs but withheld execution by keeping to himself all Engineer Department correspondence, including that of the topogs. Without such access, Abert did not even know their stations and duties and was hardly in a position to issue orders. So Gratiot's concession meant nothing until Abert was appointed to the Board of Engineers for Internal Improvements in June 1830 as coordinator of its operations.

Abert continued to lobby for an expanded role, and Porter's successors at the War Department seemed more willing to listen. In 1830 Secretary of War John H. Eaton assured Abert that the topographers would take over all civil works, including road construction as well as rivers and harbors improvements. A year later, Eaton's replacement, Lewis Cass, indicated his support for separating the duties of the Engineers and topographers, although he was uncertain whether the topogs had enough people to do all of the nonmilitary engineering work of the Army.

Finally, in 1831, with Bernard's departure and the closing of the Board of Engineers for Internal Improvements, Abert won independence for the bureau. Acting Secretary of War Philip G. Randolph signed the order that made the bureau a separate office of the War Department. The order instructed Abert to report directly to the Secretary of War, authorized him to handle correspondence and reports from topographers and other Army officers on topographical duty, and required him to comply with requests from the Chief Engineer for surveys for fortifications. The bureau's duties, as spelled out in July 1831, were both military and civil. It was charged with reconnaissance and surveys for military purposes and for internal improvements. It kept its traditional assignment as caretaker for books, instruments, maps, and charts. It also collected and preserved topographical and geographical drawings and memoirs pertaining to its duties. Now the Topographical Bureau stood on an equal footing with the Engineer Department and other elements of the Army staff. As manager of the program left by the Board of Engineers for Internal Improvements, Abert employed 12 civil

Colonel John J. Abert (1786–1863) graduated from the Military Academy in 1811, but resigned from the Army and became a lawyer. He entered the service in 1814 as a private soldier in the District of Columbia Militia and fought in the Battle of Bladensburg in August of that year. He became a Topographical Engineer in November and served until his retirement in 1861.

engineers and 30 line officers on surveys, as well as his own 10 topogs and a few officers of the Corps of Engineers. In this job, Abert's bureau, according to historian Forest Hill, "functioned in many ways as a department of internal improvements."[1]

The bureau also became involved in the construction of rivers and harbors projects during the 1830s. Until 1836 the War Department assigned all rivers and harbors construction that had been authorized by Congress to the Corps of Engineers. In 1836, however, the department gave the Topographical Bureau several Lake Champlain and Great Lakes projects, among them the deepening of harbors and channels and the construction of piers and breakwaters. Fortunately for the bureau, these coincided with a drastic reduction in canal and railroad surveys.

Obviously, ten Topographical Engineers were inadequate for the size of the mission. Regardless of the ability and energy of his own people, Abert needed more professional help. His two sources of assistance were officers from other branches of the Army and civilian engineers. Through the 1830s he employed 10 to 15 civilians and 20 to 30 line officers each year. He kept civilians and officers on separate assignments to avoid friction between the groups.

[1] Forest G. Hill, *Roads, Rails & Waterways: The Army Engineers and Early Transportation* (Norman: University of Oklahoma Press, 1957), p. 78.

With a perennial shortage of trained personnel, Abert needed a system of priorities on which to base allocations. He divided all surveys into three classes. Most important were those ordered by law, for which Congress usually provided a specific appropriation. Then came surveys ordered by resolutions of Congress, which were funded from annual appropriations for surveys. Surveys of national consequence or of a highly significant commercial character applied for by states or incorporated companies came last. The lowest category also included the loan of topographical officers to private enterprises, especially railroads. Abert honored such requests only when all surveys in the first two categories were already provided for. His most important customer was plainly Congress.

The bureau under Abert always sought ways to increase its surveying personnel and expand into new fields of work. In 1833 he asked Congress for money for geological investigations. Abert argued that national encouragement of a regular system of scientific investigation would stimulate commerce and science. Congress approved his proposal in 1834 and allotted $5,000 for an expedition. Abert hired a peripatetic English geologist, George W. Featherstonhaugh, to examine mineral deposits in Arkansas Territory. Later Abert wrangled another grant from Congress and sent the Englishman on an expedition into Minnesota.

There were other new features to the work under Abert. As early as 1834, the bureau became involved in cooperative ventures with localities. In Michigan, the home state of Secretary of War Cass, the topogs did surveys of potential improvements with money provided by communities and individuals, but only when officers were free from official duties elsewhere. This arrangement yielded most of the original surveys of lake harbors in the state. In the same decade, the bureau also lent dredges and other equipment to communities willing to pay expenses and maintenance.

Abert also felt a responsibility to disseminate as widely as possible the data accumulated at the Topographical Bureau. He considered the bureau "the depository of a great fund of geographical and topographical matter," whether on surveys of dangerous coastal bars and shoals or rivers and harbors. When possible, he honored all requests for information from publishers of maps and charts. Data included "vast numbers of approxi-

mate determinations of latitudes and longitudes" taken from various reports and charts. Abert published this information, compiled for about 500 different places of observation, in the form of a 17-page table in his 1843 report as a "Catalogue of Geographical Positions determined from astronomical observations by officers of the corps of topographical engineers, and under the orders of the bureau of the corps."

The Seminole War

With so many plans for the future and his officers thoroughly absorbed in a variety of civil projects, Abert was unprepared to meet the cartographic needs of the Army during the Second Seminole War. The first war, Andrew Jackson's campaign against the Seminoles in 1818, had employed only one of the Army's ten topographers, Captain Hugh Young. The second war placed much greater demands on the topogs. By the end of 1836, eight of the ten topographers were in the field with various forces, performing reconnaissances, collecting topographical information, and drawing maps, although only two stayed with troops very long.

Within a few months, the topogs began to catch up with the demand for maps. In 1837 the Topographical Bureau published a "Map of the Seat of War in East Florida," compiled by Lieutenant Washington Hood from data in the bureau's files. Hood, who later became a captain in the Topographical Engineers, was then an infantry officer on topographical duty. Two years later Abert's office produced a more detailed map of Florida, based on the reconnaissances of two topogs, Captain John Mackay and Lieutenant Jacob E. Blake. Topographers stayed in Florida through the 1840s, building and maintaining roads as well as collecting data, making surveys, and providing information for newer and better maps, which continued to appear through the decade.

Establishment of the Corps of Topographical Engineers

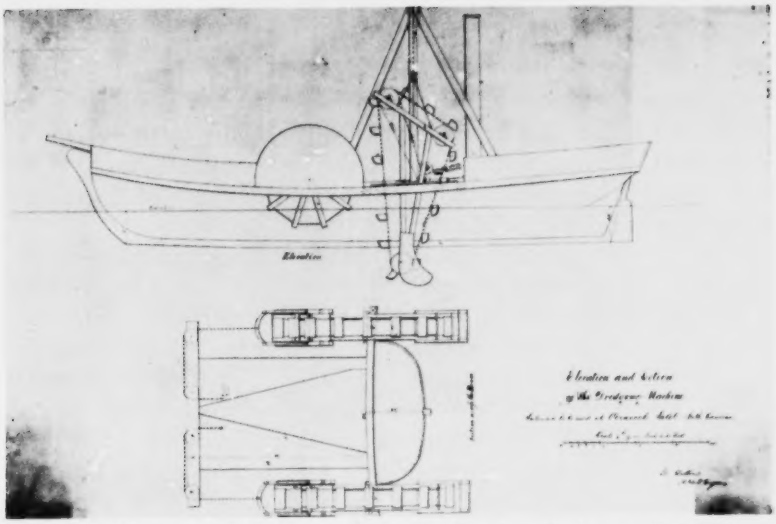
By the time of the Second Seminole War, lobbying for increased manpower and a separate corps for the topographers had gone on for at least ten years. But the war itself gave a greater boost to efforts to improve the status of the topographers than arguments by successive secretaries of war or petitions from Abert and his colleagues. The war and the expansion of the

western military frontier made plain the need for change. The Army Reorganization Act of 1838 created the Corps of Topographical Engineers, consisting of 36 officers. In addition to 1 colonel, the corps had a lieutenant colonel, 4 majors, 10 captains, and 20 lieutenants. "This law," said Abert, who was promoted to colonel in 1838 and commanded the corps from its inception until September 1861, "may be considered . . . as a new creation of the corps, giving to it the requisite rank and form, and numbers." Abert now had an independent corps, free of the Corps of Engineers, to go with the bureau that had been separate from the Engineer Department since 1831.

By expanding the number of topographers and prohibiting their employment of civilian engineers, the act ended the topogs' continued dependence on private civil engineers. During much of the 1830s, Abert had had to supplement his force of ten with officers detailed from other branches of the Army and with a number of civil engineers. For instance, in 1835, of the 49 men involved in surveying activities, 13 were civil engineers and 26 were from the line of the Army. Abert always had opposed employment of outside civil engineers, many of whom he thought incompetent, or of Engineer officers, who were not very interested in surveying work. Secretary of War Joel R. Poinsett agreed with him.

By this time, the topographical officers had established their reputation in rivers and harbors work. In fact, that renown helped justify the creation of a separate corps. However, just when the topographers achieved the status they had so long pursued, an economic recession and growing disenchantment with the cost of internal improvements moved Congress to cut drastically the level of federal involvement. The same law that created the corps repealed the General Survey Act. It also limited the use of Army engineers on behalf of private interests to times when such employment did not interfere with their official duties.

That the Corps of Topographical Engineers was created just as its work on rivers and harbors surveys declined was ironic. There were several reasons for the repeal of the General Survey Act: increasing competition from railroads; the growth of rivalries between sections, states, and cities; conflict between Congress and the President; the effects of the 1837 financial panic; continued constitutional controversy; and, finally, diminishing



In 1829 George Dutton drew this sketch of a dredge used in the improvement of the harbor at Ocracoke Inlet, North Carolina. Dutton served in the Corps of Engineers for 35 years. Between his graduation from the Military Academy in 1822 and establishment of the independent Corps of Topographical Engineers, he worked on many civil projects. His most important civil assignment was as Superintending Engineer for construction of the Cumberland Road in Ohio from 1836 to 1841. This road was the first multimillion-dollar civil project of the Corps of Engineers. In 1841, Dutton's career shifted away from civil works. Colonel Totten finally yielded to pressure from Secretary of War John C. Spencer and turned over to the topogs construction of all of his remaining civil projects. From that time until his death in 1857, Dutton worked mainly on harbor defenses.

enthusiasm among even the topographical officers due to the lack of any sort of national program or planning. The surveying duties of the topogs focused increasingly on western exploration, more traditional military missions, and specific assignments authorized by Congress. Indeed, surveying activity actually increased after 1838, although it was less directly concerned with internal improvements. Moreover, the topographers continued to be involved in critical construction projects relating to navigation around the country.

While Congress imposed limitations on the efforts of the topographers, Secretary of War Poinsett rationalized what remained in an order of 1 August 1838. With the encouragement

of the leadership of the Corps of Engineers, who thought their Corps no place for civil works, Poinsett transferred to the topogs "all civil engineering works directed by the United States," whether in progress or being considered. At the same time, he moved all plans and drawings of fortifications to the Corps of Engineers. For the next 14 years, the topographers handled all new internal improvement works, while the Corps of Engineers was responsible for fortifications.

CHAPTER III

Construction

Even before passage of the law establishing a separate Corps of Topographical Engineers, the topogs were involved in construction as well as surveying and mapping. Colonel Abert, ever alert for ways to expand the influence and mission of the topogs, as early as 1831 insisted that his bureau should build all civil works. The topogs, he argued, were best suited to do so because they did the surveying, plans, and estimates. The Topographical Bureau began to undertake lighthouse construction in 1834 at the order of Secretary of War Lewis Cass. By 1838 the bureau's construction activities, which included lighthouses and beacon lights, monuments, and even bridges and aqueducts, actually surpassed surveying in importance.

In securing a construction mission for the topogs, Abert exploited the disinterest shown by the Corps of Engineers and its new chief, Colonel Totten, who replaced Gratiot at the end of 1838 and retained the office for 26 years. Abert claimed that "several of the distinguished officers of the corps of engineers," including Totten, "always viewed the superintendence of these civil works as an embarrassment to the proper functions of their own corps, and foreign to them; and with a just and enlightened consistency, always befriended those propositions before Congress, the tendency of which was to remove the obstacles before referred to, in the way of a proper arrangement of duties." As accurate as this assessment may have been, Totten still resisted turning over the more important of the 70 works under his charge in 1838. These included the Cumberland Road; piers at St. Louis; the lighthouse near Sandy Hook; and improvements on the Arkansas, Hudson, Mississippi, Missouri, and Ohio rivers. The law had assigned these projects to the Engineers, and a law was required to transfer them elsewhere. Secretary of War John C. Spencer finally forced Totten to relent in 1841, and the topogs monopolized federal civil works into the 1850s.

The Corps of Topographical Engineers undertook much of

this construction for the Treasury Department. In addition to its traditional responsibilities of minting coins and issuing paper money, the department oversaw the operations of the Coast Survey and of the Customs, Lighthouse, and Marine Hospital services. Overburdened by the size of these varied operations, secretaries of the treasury turned to the topogs for construction services. The Treasury Department asked that officers be detailed for service on these various projects. Abert objected to details; he considered them a serious drain on his manpower and always preferred to take on a duty or mission rather than detail his men elsewhere to work for someone else. Any job, he claimed, "would be better done, in less time, more economically, and with fewer discontents, as the officer would be kept under his accustomed discipline and laws and regulations."

Lighthouses

Topog involvement with lighthouse construction dated from 1834. That year, Captain Hartman Bache did the survey for the Brandywine Shoal Lighthouse in Delaware Bay. However, this precedent did not expand into a major mission. It nearly did so in 1842, when a House committee considered transferring the Lighthouse Service to the Topographical Bureau. Nevertheless, not until 1847 did Congress assign six lighthouses to Abert's corps. These lights drew on the experience of Captains William H. Swift and George W. Hughes, who had studied lighthouses in Europe.

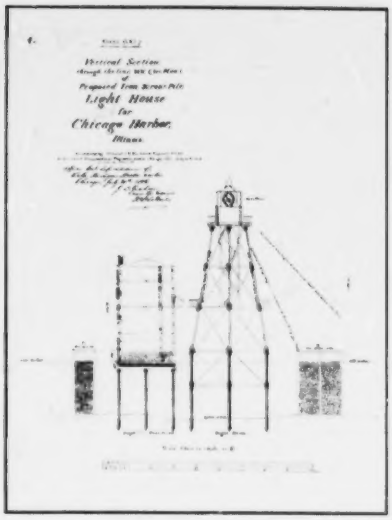
Construction of these "lights" proved a real burden to the topographers. Uncharacteristically, Abert was not enthusiastic about getting this job. He was not consulted before passage of the law that assigned him the task, which he considered a drain on his meager manpower. The mission, which spread the topogs up and down the East Coast from New England to Florida, and as far west as Michigan, did not come with additional resources. In the 1850s, as many as 9 of Abert's 35 officers were under orders to the Lighthouse Board.

In 1851 Congress divided the responsibility for lighthouses between the topographers and the Coast Survey. The topogs were charged with preliminary surveys for lighthouses, lightboats, beacons, and buoys on the Great Lakes. The Coast Survey took on surveys for seaboard lights, with the Secretary of the Trea-

Joseph G. Totten (1788–1864) was Chief Engineer from 1838 to 1864. A specialist in coastal forts, he understood the impact of new naval technology, including steam vessels, on land defense. Totten was a regent of the Smithsonian Institution and helped organize the National Academy of Sciences. In civil engineering, he did important work on the composition of mortars and wrote *Hydraulic and Common Mortars*, published by the Franklin Institute of Philadelphia. A conservative, reserved man with a strong sense of duty, Totten tended to do too much himself rather than delegate tasks to subordinates. Still, he found time to help younger officers and to pursue his interests in geology, mineralogy, and conchology.

sury overseeing the entire operation. A board was set up to examine the state of the nation's lighthouses. Lieutenant Colonel James Kearney, a senior officer of the Corps of Topographical Engineers, was one of the six members. The board recommended establishing a nine-member Lighthouse Board to administer the Lighthouse Service and the assignment of Army and Navy officers as inspectors to oversee construction, maintenance, and operations in each of the lighthouse districts.

In October 1852, Congress approved the planning board's recommendations and established "the Lighthouse Board of the United States." Its members included two senior naval officers, one Engineer, one Topographical Engineer, two civilians "of high scientific attainments," and two secretaries. Lieutenant Colonel Kearney sat on the board until 1856, when Captain Andrew A. Humphreys replaced him. Bache succeeded Humphreys in 1862. More junior members of the corps, the first of whom was Lieutenant Edmund L. Hardcastle, served as one of the secretaries. The board divided the nation's coasts into 12 districts and instituted rules for operation of the lighthouse establishment. An officer assigned to each district as inspector disbursed funds and supervised the work of the lighthouse keepers; another officer appointed as engineer oversaw construction and maintenance. The law that set up the board assigned three specific



This diagram of a lighthouse for Chicago Harbor came from Major James D. Graham's 1854 report. The screw-pile lighthouse is an example of early iron truss technology. It was developed in England and imported by the Army topographers in the 1850s.

lighthouse operations to the topogs. These were evaluation of the plan for erecting a lighthouse on outer Minot Ledge in Boston Harbor; supervision of construction of a first-class lighthouse near Coffins' Patches, off Dry Bank, Florida; and construction of four beacon lights—two for Gedneys Channel, New Jersey, and two on Staten Island in New York Harbor.

Generally, when Topographical Engineers oversaw the construction of lighthouses, the Treasury Department transferred the responsibility to their corps. Before beginning construction, a topographer forwarded a survey of the site and a detailed report to Abert for approval. During construction, the topog submitted periodic progress reports and managed the entire project without the involvement of the Treasury Department. After completion of construction, including installation and testing of the light, the corps turned the lighthouse over to the Treasury Department.

Some officers, such as Hartman Bache, developed a keen interest in the work of the Lighthouse Service. He began work on the Brandywine Shoal Lighthouse in 1834 and in the 1850s was the 12th Lighthouse District inspector and engineer. While on the West Coast, he invented a fog signal based on a locomotive steam whistle. Air forced through a pipe by the rush of seawater made the whistle blow. Bache's signal worked until a very

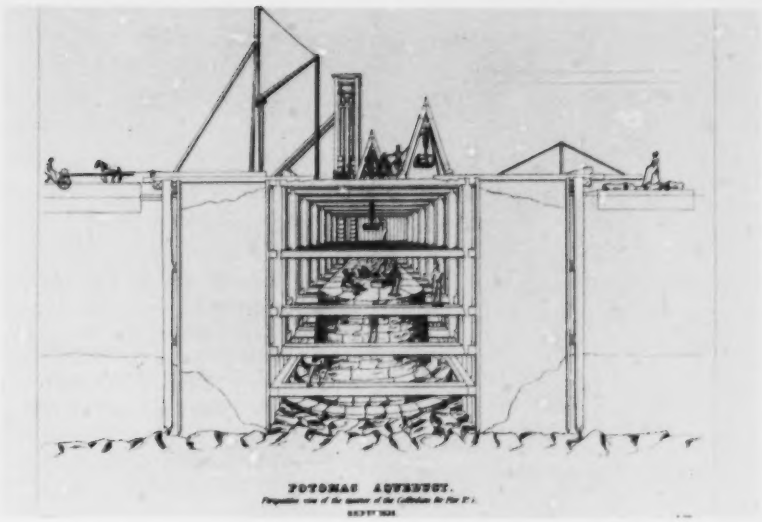
James Kearney was born in Ireland. He volunteered for service during the War of 1812, entered the Army as a third lieutenant of infantry, and served nearly 50 years. He rose to the rank of lieutenant colonel, second in seniority only to John Abert. This pen-and-ink portrait of Kearney was made by an unidentified lieutenant in about 1850.

powerful blast of air blew apart the support structure for the apparatus. Undaunted, he rebuilt the signal, added a safety valve, and got more than 12 years of use from the system.

Marine Hospitals

Topographical Engineers also oversaw the construction of marine hospitals. The Treasury Department administered the Marine Hospital Service, whose hospitals for sick and injured seamen were financed by deductions from their salaries. As inland shipping increased, marine hospitals became necessary along the rivers and Great Lakes as well as on the coast. Robert Mills, the Architect of Public Buildings, executed standard drawings for the inland marine hospitals in 1837 for sites already chosen by the Surgeon General. The Treasury Department asked Abert to detail officers to oversee the construction, using Mills' design. The topogs then would transfer completed structures to the Marine Hospital Service.

In 1845 Major Long was instructed to erect a marine hospital at Louisville, Kentucky. However, the Mexican War halted the project. After the war, Abert assigned Long three more hospital projects at Paducah, Kentucky; Natchez, Mississippi; and Napoleon, Arkansas. First Lieutenant Joseph Dana Webster also began work on a marine hospital at the former site of Fort



This illustration of the Potomac aqueduct under construction was done by civil engineer M.C. Ewing from a sketch drawn by Washington Hood during the period between Hood's resignation from the Army as an infantry officer and his joining the Corps of Topographical Engineers.

Dearborn, in Chicago. Both officers took on these duties in addition to other responsibilities. Heavy rains hampered Long's progress at Paducah in late 1849 and early 1850. At Napoleon, eroding riverbanks convinced him the hospital should be moved to Helena, but the Treasury Department insisted on the original site. The hospital opened its doors to seamen in 1855 but slid into the river 13 years later. In a few years, the town went the way of the hospital.

The New Orleans Customs House

One of Abert's officers also became involved in constructing a customs house. In 1848 the Secretary of the Treasury asked that Major William Turnbull, who had just returned from the Mexican War, oversee construction of the new customs house foundation in New Orleans. It was a small and singular type of job, and Abert did not insist on transfer of the work to his office. The Topographical Bureau detailed Turnbull to the Treasury Department, and he went to New Orleans in September 1848. Aware of the ground-water problems in the city, Turnbull studied other

One of the Washington aqueduct piers under construction inside a coffer dam.

foundations to ensure that his would support the new building. He disliked the assignment, complaining that Treasury Department personnel consistently disapproved his estimates, refused to pay his bills, and assigned him the "irksome" duty of "imbursements." In late October 1849, after completing the foundation, Turnbull asked for relief. Abert granted his request in early December.

Washington, D.C.

Working with civilian engineers and the Corps of Engineers, the topogs helped change the District of Columbia from a village into a modern capital city. Specifically, the topogs built the first federal water supply in the District, conducted surveys, paved roads, and built bridges and public buildings. Their work in the city predated establishment of the Corps of Topographical Engineers and could even be said to have started before establishment of the Corps of Engineers. In 1791 Isaac Roberdeau, then a civilian, had worked with Major Pierre L'Enfant on the initial survey of Washington. He came back in 1822 as a Topographical Engineer and supervised construction of a conduit bringing a more reliable water supply to the White House.

Providing for the supply of water to the federal areas developing around the White House and the Capitol Building was a topog responsibility until 1852, when it passed to the Corps of Engineers. Fear of fire sporadically motivated Congress to provide funds for studies and construction of piping to locate and bring spring water to the two centers of the young federal government. In 1830 a civil engineer working for the topogs studied the city's springs, identifying the best sources of water. Two years later, Congress had the water piped to the Capitol and surrounding area.

Finally, in 1850, the legislators decided it was time to consider a water supply system for the entire city. Topog Captain George Hughes conducted that study, proposing to use Rock Creek inside the District boundaries to provide 12 to 22 million gallons per day. Congress did not act on his recommendation. Two years later, after a fire in the Capitol, the legislators again asked for a comprehensive inquiry. Colonel Totten convinced Congress to assign the work to the Corps of Engineers. Lieutenant Montgomery C. Meigs got the job and became superintendent of the construction that followed. From that time on, responsibility for the District's water supply passed from the Topographical Engineers to Totten's organization.

The topogs also constructed bridges, a vital feature of any riverine city. William Turnbull, who was then a captain, managed the most important of these projects, the aqueduct over the Potomac River. A significant engineering achievement, the aqueduct allowed canal boats using the Chesapeake and Ohio Canal on the Maryland side of the Potomac to cross over to Virginia at Georgetown and carry their cargoes directly to the port of Alexandria, Virginia, without having to stop at the river. Between 1832 and 1843, Turnbull designed and built the quarter-mile-long wooden trough, supported by two stone abutments and eight masonry piers that extended a minimum of 36 feet under the water. Although much modified, this bridge was not replaced until completion of today's Francis Scott Key Bridge in 1923.

Working with the civilian architect Robert Mills, Captains Campbell Graham and Hughes helped plan a new War Department building. Andrew Humphreys, then a lieutenant, supervised construction of a bridge over Rock Creek, and later worked with architect William Strickland in designing a new hall for

the House of Representatives. Topogs also worked on other federal projects in the District, although some of their efforts never reached fruition. For example, in 1848 they carried out a major survey of Potomac River crossings that included estimates for the repair of the Long Bridge, construction of a bridge at the aqueduct in Georgetown, and maintenance of a steamboat ferry in lieu of a Potomac River bridge. After having asked for the survey, Congress provided no funds for construction. During the decade that followed, the topogs conducted at least two more surveys of the Potomac in the Washington area.

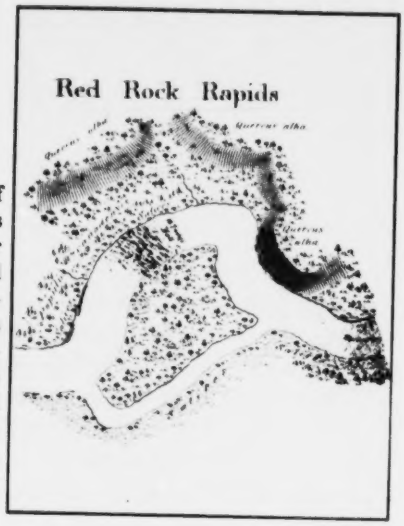
The Topographical Engineers also carried out a major improvement project on Pennsylvania Avenue. Captain Hughes started the job in 1845 with a plan and cost estimate. Hughes proposed a pebble pavement for carriages and wide brick sidewalks with a 20-foot gravel center strip dividing traffic on what Hughes called "this noble street." Because the level of the avenue made it "the general recipient of the drainage of the higher ground through the lateral streets," with water, sand, and mud pouring onto the road from the north, the plan also included the 15th Street storm sewer. Hughes did not get the chance to carry out the plan. After the start of war with Mexico, he was reassigned to forces operating in the enemy's northern provinces. Captain Graham carried out the project in two construction seasons, 1847 and 1849, contracting for materials but hiring his own workers. He then surveyed James Creek, a stream that carried both cargo and sewage from Capitol Hill to the Anacostia River, in 1851 to 1852.

CHAPTER IV

Navigation

Most civil works transferred to the Topographical Bureau by the Engineer Department in 1838 through 1841, in accordance with Poinsett's order, involved rivers and harbors improvements. A large number of these were along the shores of the Great Lakes. In the years that followed, this activity declined. In 1841 Congress appropriated money only for the Potomac River aqueduct and bridge and for removal of the fallen trees and other debris that clogged the Red River of Louisiana. Work on the Red River "raft" had been suspended for some time. On Lieutenant Colonel Long's recommendation, a contract was let for the work. With these exceptions, 1841 was a lean year. "Other various works of river and harbor improvements," Abert wrote, "have been comparatively suspended, existing appropriations in reference to the same authorizing nothing more than the payment of arrearages, and such additional expenditures as should be necessary, in order to preserve the boats, machinery, and materials from destruction."

From 1838 until after the Civil War, only two significant rivers and harbors acts passed; one in 1844 and another in 1852. Some other acts authorized work on a few specific projects, but those were modest when compared with the laws passed in the early 1830s. Sometimes, as in 1841, Colonel Abert was forced to instruct his subordinates to suspend work and even to sell equipment to meet congressionally imposed funding limitations. In 1850 he told Captain Augustus Canfield, who was in charge of works near Detroit, that the money credited to him for his project came from funds "for the repair and construction of roads and bridges for the use of armies in the field." A decision by Secretary of War Jefferson Davis in 1853 allowed the use of local funds to continue projects that had already received some congressional appropriations. The ruling helped, but it was hardly a panacea.



John C. Frémont prepared a map of the Des Moines River, including this drawing of Red Rock Rapids, after surveying the stream in 1841. He had been assigned the job at the insistence of Missouri Senator Thomas Hart Benton, who tried unsuccessfully to disrupt the budding romance between his daughter Jessie and Frémont. Although 1841 was a lean year for rivers and harbors work, Abert somehow found the money to accommodate Benton.

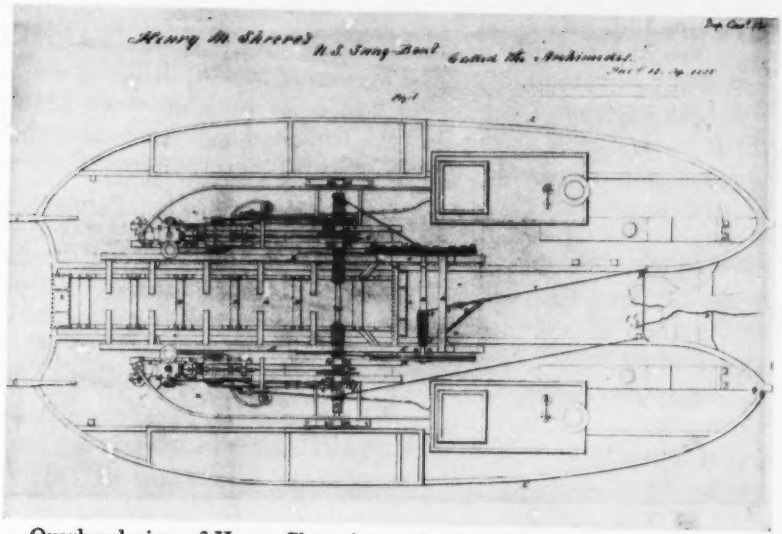
Congressional indifference was not the only problem. Successive Presidents continued to express doubts about the constitutional propriety of federal involvement in internal improvements, and several bills were vetoed during this period. The politics and personal predilections of the Secretary of War could also substantially alter the responsibilities of the Topographical Engineers. The most significant example of this came in 1852, when Secretary of War Charles Conrad decided that the Corps of Engineers would henceforth be responsible for rivers and harbors improvements on the Atlantic Coast, the Gulf of Mexico, and the rivers flowing into those two bodies of water. The Corps of Topographical Engineers retained the responsibility for improvements on the Great Lakes and the western rivers. Both organizations worked on the Mississippi River, with the Corps of Engineers concentrating on problems at the mouth of the river.

Conrad's decision largely resulted from passage of the 1852 Rivers and Harbors Act. Clearly, there were too few topographical officers to handle the increased work load, particularly when some had been detailed to other agencies and projects. The Secretary could have opted to use civilian engineers, but rejected that solution because he doubted their qualifications. He could have chosen to expand the Corps of Topographical Engineers, but he and Abert did not get along particularly well. Besides, at that

time the Corps of Engineers was relatively inactive because Congress had recently denied funds for fortifications construction and was investigating the system of coastal defenses upon which the Corps of Engineers had been working since 1816. Totten and Conrad agreed that the time had come to involve the Corps of Engineers once more in internal improvements. Hence, Conrad decided to split the work between the two corps. He also directed that each corps establish a board to supervise rivers and harbors projects. The Topographical Bureau's Board of Engineers for Lake Harbors and Western Rivers met from 1852 to 1855, when it was dissolved under Jefferson Davis, Conrad's successor as Secretary of War.

Although rivers and harbors improvements were carried out at an uneven rate, Topographical Engineers had an abiding faith in the importance of their work and in their ability to do it. "The improvement of rivers . . . may justly be considered as the most difficult problem of solution in the whole science of civil engineering," Captain Hughes wrote in 1842. The answer to safe navigation was not construction of huge canals that drew water from the rivers but largely avoided natural watercourses. The answer, Hughes said, was to use human intelligence to "assist nature in her operations." It was a hopeful statement, full of that positivism characteristic of France during the Enlightenment a century earlier. Topographical Engineers deeply believed it, and even when the laws of nature seemed beyond their grasp, they sought to control the rivers.

They did so by constructing wing dams, jetties, and dikes. They built locks on some waterways and anticipated systems of locks and dams—slackwater navigation systems—on others. Actual work on many of these navigation systems, such as those on the Cumberland, Tennessee, and Ohio rivers, began only after the Civil War. Where structures proved ineffective, dredging was done. More often than not dredging was found to be necessary periodically no matter how well the structure worked. In their harbor projects, Topographical Engineers experimented with different types of cribs as breakwaters and as aids in the passage of water over sandbars. They tried to keep up with related work in Europe and were quick to borrow promising technology, such as the use of concrete in jetty construction, a practice pioneered by the French. They made substantial contributions to engineering, ever believing that science and technology eventually would



Overhead view of Henry Shreve's snagboat *Archimedes*, one of "Uncle Sam's tooth-pullers."

provide answers to the challenges of controlling the nation's waterways. And they felt that where theory failed, ingenuity would succeed. Theirs was a compelling faith, suited to a young, sinewy nation that sensed destiny was in its hands. It molded the nation's attitude toward water resources development and became part of the culture of the Corps of Engineers.

The Topographical Engineers did their best to meet the internal navigation needs of the nation. Through careful surveys, they helped chart the shores of the Great Lakes and the Atlantic Ocean. They did their construction work usually with modest, and often patently insufficient, appropriations. From Texas to Maine, from Minnesota to Florida, topogs constructed piers, breakwaters, and seawalls. They built dredges, snagboats, pile-drivers, and other machinery. Blasting rock, removing bars, and clearing river obstructions, the topographers remolded the land. Their rivers and harbors improvements dotted the landscape.

The Great Lakes

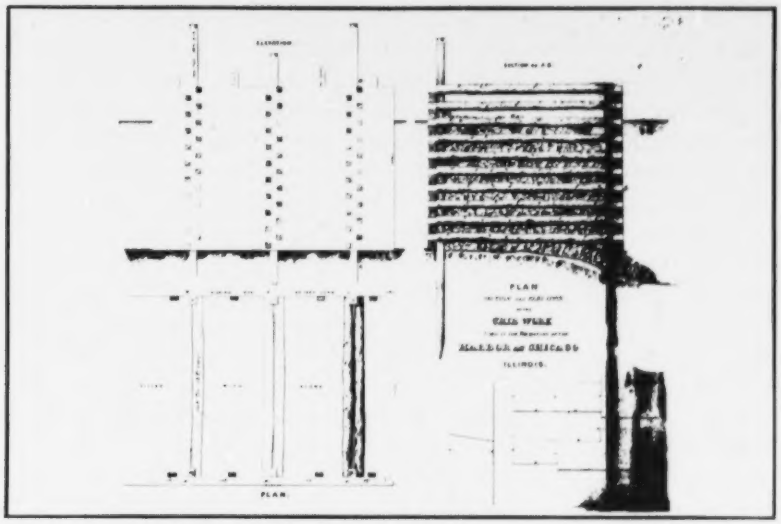
The topographers had strong support for their work on the Great Lakes from some secretaries of war. John M. Porter reminded Congress that the Great Lakes harbors and western

rivers were vital to safe commerce and naval operations on the lakes in time of war. Porter's successor, William L. Marcy, also tied public works to defense, particularly as related to the Great Lakes. If the nation ever had to put a naval force on the lakes, he argued, numerous and commodious harbors provided with federal aid would contribute to the fleet's safety and success.

In fact, the topographers always concentrated a large part of their efforts on the Great Lakes. Harbor work on the lakes began in the late 1820s and continued throughout the antebellum period. One of the earliest appropriations was for a breakwater at La Plaisance Bay, Michigan. However, Chicago Harbor received the most work and the most money. Indeed, about one-quarter of the approximately $1 million spent for projects in the Huron-Michigan basin before the Civil War went to Chicago. Building a harbor there entailed dredging a navigation channel and constructing two piers. When congressional appropriations temporarily ceased after 1838, the city of Chicago provided some funds for continued dredging. Unfortunately, the timber piers rotted and crumbled and, without enough money, the topographers could not prevent the harbor's deterioration in the decade prior to the Civil War.

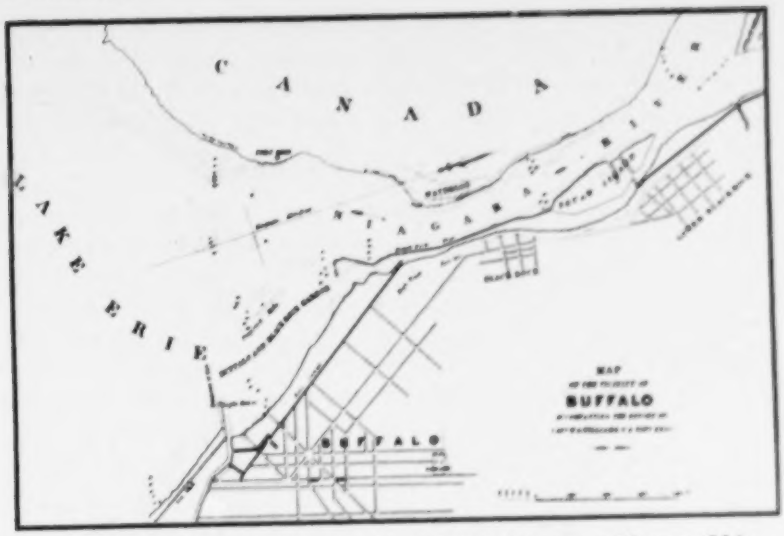
The corps worked on numerous other harbors around the Great Lakes. These included Waukegan, Illinois; Michigan City, Indiana; La Plaisance and St. Joseph, Michigan; Milwaukee, Kenosha, Racine, and Sheboygan, Wisconsin; Cleveland and Sandusky, Ohio; Presque Isle (Erie), Pennsylvania; and Buffalo, New York. The Presque Isle project—a double row of stone-filled cribs extending out into the bay—was a case in which the officers of the Corps of Engineers bequeathed to their topog rivals a project that had been destroyed by storms and shoaling and that required substantial modification. But, again, without congressional funding such work was impossible, and Colonel Abert could do little in response to the pleas of Erie citizens.

One well-known project that involved the topographers in a somewhat unusual way was the construction of the locks at Sault Ste. Marie, Michigan. Secretary of War Porter proposed the Soo locks in his 1843 report. In 1852 Congress agreed to help Michigan connect the upper and lower lakes by granting $20,000 and 750,000 acres of federal land to build a channel and locks between Lakes Huron and Superior. Although it was to be a state project, Captain Canfield volunteered his services. Not only



Captain John McClellan drew this plan for cribwork during his 1843–1846 tour of duty on Lake Michigan. An 1826 graduate of the Military Academy and artillery officer for 10 years, McClellan resigned from the Army in 1836, then returned as a topog during the 1838 expansion of the corps. He served in the Seminole War before working on the Great Lakes. Later he won a brevet promotion for "gallant and meritorious conduct" in the Mexican War battles of Contreras and Churubusco and worked on the Mexican boundary survey. Known as a hard drinker throughout his career, McClellan died in 1854.

did Abert allow Canfield to direct the project as a nominal employee of the state of Michigan, but he also permitted use of most of the $20,000 appropriated by Congress to have a dredge boat built. Canfield's design for the canal conformed to the congressional stipulation that the passage should be not less than 100 feet wide and 12 feet deep, with two locks at least 250 feet long and 60 feet across. When Canfield died unexpectedly in 1854, his responsibilities were assumed by Lieutenant Colonel James D. Graham, who was headquartered in Chicago and responsible for improvements on Lake Michigan. In 1856 Captain Amiel W. Whipple took charge of the project. He used private funds and an additional $45,000 congressional appropriation to complete in 1858 a rough channel connecting Lakes Superior and Huron. After the Civil War, the state transferred title to the canal to the United States. The Corps of Engineers took over the canal and lock operations and considerably improved them.



Captain William G. Williams, who included this map with one of his reports on Buffalo Harbor, worked for many years on the Great Lakes.

Great Lakes Survey

Perhaps the best-known work of the Topographical Engineers on the Great Lakes was not a construction project, but the Great Lakes Survey. The need for the work had long been recognized, for the uncharted lakes posed significant navigation hazards. Work actually began with a $150 survey of the harbor at Presque Isle on Lake Erie in 1823, but Congress did not provide funds for a systematic survey until 1841. The appropriation made at that time was a predictably modest $15,000. Colonel Abert assigned direction of the survey to Captain William G. Williams, who had been general superintendent of harbor improvements on Lake Erie. Williams operated out of Buffalo, with four Topographical Engineers under his command.

Despite the modest and belated support given to the Great Lakes Survey, the subsequent years revealed a rare congressional consensus on the importance of the work. From 1841 to 1860, Congress voted a total of $640,000 for the survey; funds were provided in 18 of those 20 years. The work itself was daunting. Some 6,000 miles of shoreline needed to be surveyed. The surveyors had to determine latitude and longitude; measure

the discharge of rivers into the lakes; survey rivers, narrows, and shoals; develop charts and maps; and mark points of danger.

For the survey, Williams built the first iron-hulled steamer on the upper lakes. The 95-foot vessel was commissioned the *Abert* in May 1844 and renamed *Surveyor* the next year. The survey used the vessel for 30 years. Survey parties built triangulation stations, from 10 to 25 miles apart, and preferably on elevated land for visibility. The surveyors traced a chain of triangles over the lakes, connected where a lake was too wide by a series of smaller triangles along the shore. The days were long, the weather was often poor, and the summertime flies and mosquitoes swarmed around the men. But the work progressed, and in his four-year tenure Williams oversaw the survey of all Great Lakes harbors except those on Lake Superior.

The first surveying was somewhat crude, but as better instruments and more manpower became available, the quality improved. Lieutenant Colonel Kearney, Williams' successor, took over in 1845. The focus of the survey was shifting westward by that time, and the office's move to Detroit bore witness to the change. Kearney oversaw the completion of the first comprehensive chart of Lake Erie in 1849. The same year also saw the publication of the first atlas of charts of the portions of the lakes covered to that time. Survey offices in Buffalo, Cleveland, and Detroit issued the maps to navigators without charge up to the Civil War. Captain John N. Macomb, who took over from Kearney in 1851, had a second steamer built and started the survey of the Straits of Mackinac, perhaps the most difficult part of the Great Lakes to chart. By 1855 the survey fleet included five steam-driven dredges and accessory discharging scows.

With characteristically broad vision, Colonel Abert saw the survey in the most far-reaching terms. "These lakes," he wrote, "constitute a great northern sea-board." At almost every turn, he urged Congress to provide more money, buttressing his arguments for increased support by reminding the legislators of the thriving lake trade and backing his claim with the commercial statistics that he required the head of the survey to collect.

Captain George G. Meade, later the commander of Union forces at the Battle of Gettysburg, headed the lakes survey from 1857 to 1861. Under his guidance, the surveyors improved their scientific procedures and began to take meteorological readings. In 1859 Meade set up 19 weather stations on the five lakes. In

James D. Graham (1799–1865) worked on the Great Lakes from 1854 to 1864, much of that time as superintendent of harbor improvements with his office in Chicago. A thinker as well as an engineer, Graham discovered the existence of a lunar tide on the Great Lakes. After graduating from the Military Academy in 1817, he became an artillery officer and assisted Long on the 1819 expedition to the Rockies. Graham worked on four major boundary surveys: the northeastern boundary with Canada, the border between the United States and the Republic of Texas, the Mexican boundary, and the resurvey of the Mason-Dixon Line.

addition to gauging the weather, he also sought to predict it and warn mariners of impending storms. At the beginning of the Civil War, the lakes survey was the most active of any topog field office, although only the survey of Lake Huron was complete. In 1863, when the Corps of Topographical Engineers was reincorporated into the Corps of Engineers, the lakes survey became the only topog office to outlive the parent organization. The lakes survey retained its identity, and its superintendent reported to the Chief of Engineers. The survey office continued until 1970, when many of its functions were transferred to the National Oceanic and Atmospheric Administration. The Detroit District of the Corps of Engineers assumed the responsibility for forecasting lake levels.

U.S. Coast Survey

Like the Great Lakes Survey, the Coast Survey predated the establishment of the Topographical Bureau. The effort had started within the Treasury Department in 1816 under Swiss-born Ferdinand R. Hassler. This was the first contact between that department and the topogs, who in later years undertook much construction for the Treasury. Colonel Abert, then a major, worked for the survey for two years. In 1818, after temporarily being taken over by the Army and Navy, work was suspended for

lack of funds. As soon as he secured the independence of the Topographical Bureau in 1831, Abert expressed the need for a coastal survey. Topographical Engineers, Abert claimed, were the only ones with sufficient technical knowledge and the requisite discipline for the job. As to the work, Abert claimed it had great value for commerce and science as well as for defense. Moreover, he would have been eager to do it, but Congress rebuffed his efforts to add the survey to the missions of the bureau.

Appropriations resumed in 1832, and Abert detailed Captain William H. Swift to the project at Treasury's request four years later. However, it was not until the reorganization of 1843 that the topogs began to play a major part in the survey. The law of 1843 set up a board of officers to design a plan for the project. This board consisted of four "from among the principal officers" of the Corps of Topographical Engineers, the superintendent of the survey and his two main assistants, and the two naval officers then in charge of hydrographical parties. The topogs were assigned implementation of the topographical portions of the plan. From that time until the Civil War, one topog officer was always detailed to the survey.

The Coast Survey itself had only a small staff and relied on Army and Navy personnel to accomplish much of its surveying in the antebellum period. Several officers represented the topogs with the survey, including Joseph E. Johnston, Thomas Lee, Thomas Jefferson Cram, and James H. Simpson. For almost a decade, 1833 to 1834 and 1836 to 1843, Captain Swift was the Coast Survey's disbursing officer. Captain Humphreys served as Assistant in Charge from 1844 to 1850. Those officers who worked with the survey added their surveying and exploration background and skills to the project while gaining experience with instruments and equipment peculiar to the coastal survey.

The Mississippi River System

The Topographical Engineers also were active on the Mississippi and its major tributaries. Work on these streams was initiated in 1824 by Stephen Long, so it was fitting that Abert appointed Major Long to head up the Office of Improvements of Western Rivers in 1842. This large rivers and harbors office, with far-flung responsibilities, never had much success. Abert had

envisioned dividing Long's operation into "five district sections or commands," each with a topog in charge, but these were never created. Long's office was established with an appropriation of $100,000 for the improvement of the Ohio, Mississippi, Missouri, and Arkansas rivers.

Contrary to Abert's wishes, Secretary Spencer established a separate office to supervise improvements on the upper Ohio River. This was apparently in deference to political pressure from that part of the country. In any case, the arrangement proved administratively awkward. Long assumed that the superintendent of improvements on the upper Ohio, Captain John Sanders, temporarily detailed from the Corps of Engineers to Abert's command, would be subject to Long's authority. Abert disabused Long of that notion, but not without periodic complaints from the unhappy major.

One of Long's principal duties was to supervise snagboat operations. In the 1840s, the six to ten snagboats that worked on the western rivers removed over 160,000 obstacles, ranging from snags, stumps, and logs to overhanging trees. The crews numbered from 40 on the largest boats to 30 on the smallest. To ensure a just and consistent administration of the crews and boats, Long authored a set of *Rules and Regulations*. The document prescribed the rights and duties of the crew and specified rules relating to pay, furloughs, gambling, drinking, medical treatment, and food. Despite this attempt at imposing a fair policy, snagboat captains—themselves not always free of guilt—experienced numerous cases of desertion and insubordination from their crews.

Long's office did little after the Mexican War, until the 1852 Rivers and Harbors Act appropriated $500,000 for improvements on western rivers. He then started an intensive program for removing obstructions from the principal waterways under his authority. This effort lasted four years. He also supervised the improvement of the harbor at Dubuque, Iowa; work on the especially difficult stretches of water at the Des Moines and Rock River rapids on the upper Mississippi and Illinois rivers, respectively; the removal of the Red River raft; and the repair of the Cumberland Dam on the Ohio River. While Long supervised this work, he also had to address a controversy with Secretary of War Jefferson Davis, who was upset that Long employed John Russell, a Whig and therefore politically unacceptable to Davis.

Long claimed to be ignorant of the order to fire his long-time assistant. He nevertheless incurred sizable displeasure from the Secretary, who temporarily relieved him of his position in 1853.

Long returned to his headquarters in Louisville in 1855, but soon afterward he was involved in another dispute with Davis. A delay in dredging operations at Dubuque, which resulted from interference with Long's operations by a private contractor employed by the city, irritated the Secretary of War. To appease Davis, Long entered into a contract that proved unfavorable to the government. This time Abert was upset, and he recommended to Davis that Long be removed. Davis needed no urging. With Long's removal in 1856, the Office of Improvements of Western Rivers was effectively abolished. During its life, it had exhibited all the characteristics of topog field offices: dependence on erratic congressional appropriations; alternate periods of intense activity followed by little or no work; political interference; shortages of qualified personnel; and lack of overall planning and continuity.

Long's office was one of five topog field offices that carried out rivers and harbors work during the 1850s. Captain John McClellan ran the Office of Tennessee River Improvements at Knoxville, while Graham's office in Chicago worked on Lakes Michigan and St. Clair. Two other offices also oversaw Great Lakes operations. Captain Howard Stansbury at Cleveland managed work on Lake Erie west of the port of Erie; Major Turnbull at Oswego, New York, had the rest of Erie and Lakes Ontario and Champlain. Lieutenant Colonel Kearney's Board of Engineers for Lake Harbors and Western Rivers, established in 1852, oversaw the whole operation from an office in Washington.

The Mississippi Delta Survey

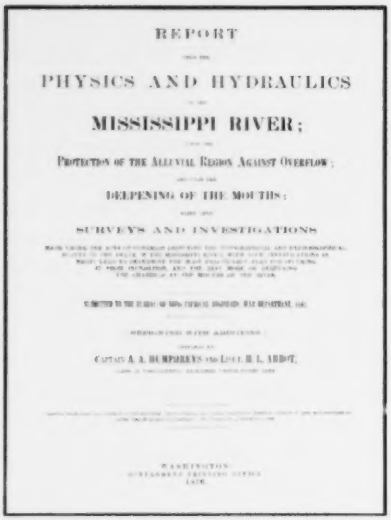
The Topographical Engineers performed one especially significant waterway survey, one atypical in organization and important far beyond the funds and time invested in it. This was the Mississippi Delta Survey. In September 1850, responding to the pleas of southern congressmen for federal assistance in dealing with periodic disastrous flooding at New Orleans and other lower Mississippi River communities, Congress appropriated $50,000 for a topographical and hydrographical survey of the Mississippi Delta. The survey was to include a study of the

best means of securing a 20-foot navigation channel at the Mississippi's mouth. Captain Humphreys and Lieutenant Colonel Long were placed in charge of the survey. However, Long was preoccupied with the construction of marine hospitals and other duties, so Humphreys assumed overall supervision of the project.

Humphreys came from an assignment with the Coast Survey. Earlier, he had worked on the extension of the Capitol in Washington and on the construction of Chicago Harbor. He met this new challenge with his customary vigor, organizing three teams of surveyors—hydrographical, hydrometrical, and topographical—and putting a civilian engineer in charge of each of them. The laborious work in the hot climate exhausted Humphreys. He had to go home to Philadelphia to recuperate, and the survey remained uncompleted. He returned to the survey in 1857, the intervening time being taken up principally with supervising the Pacific railroad surveys. When he resumed work, he had a new associate, Lieutenant Henry L. Abbot. Abbot proved so indispensable that when the final report was published, Humphreys added his name as coauthor. Officially titled the *Report Upon the Physics and Hydraulics of the Mississippi River*, the survey is often called the Humphreys-Abbot report.

In 1861 Humphreys and Abbot closed the office and submitted their report, which was full of new details about the lower Mississippi basin. From just south of the junction of the Mississippi and Ohio rivers to the mouth of the great river, they obtained data on river flow, channel cross sections, and general topographical and geological features. Survey teams took similar measurements on some of the major tributaries of the lower Mississippi. The two officers then examined all available literature on channel resistance and water flow, altogether examining some 15 different formulas. They found every calculation lacking in some respect. So they developed their own formula to measure the flow of water in rivers, which also proved faulty. Most significantly, it did not take into account the roughness of the slopes of a river channel. Still, their work inspired other hydraulic engineers, and further research led to important theoretical discoveries. The report won the respect of engineers around the world.

Unlike other West Point graduates, Humphreys and Abbot had actually tested the European theories they had learned at West Point. Moreover, they did so in a comprehensive and lucid


REPORT

PHYSICS AND HYDRAULICS

MISSISSIPPI RIVER;

PROTECTION OF THE ALLUVIAL REGION AGAINST OVERFLOW;

DEEPENING OF THE MOUTHS;

SURVEYS AND INVESTIGATIONS

The 1876 edition of the Humphreys-Abbot report appeared when Humphreys, then Chief of Engineers, was feuding with a famous civil engineer, James B. Eads, about the effectiveness of jetties at the mouth of the Mississippi. Eads thought jetties could ensure navigable passage at the river's mouth. Humphreys clung to the analysis in his report and insisted they could not. In 1879, Eads completed jetties at the South Pass of the Mississippi and showed them to be effective. Eads' triumph partially discredited the Humphreys-Abbot report, but the report's insistence on "levees only" to control the river remained a canon of Corps flood control theory.

fashion that was unprecedented. Their publication not only helped validate their education and training, but it suggested that the Topographical Engineers could make technical contributions that were as important as those of their fellow officers in the Corps of Engineers. The report also affirmed the faith articulated in 1842 by Captain Hughes: careful observation and experimentation leads to an understanding of the laws of nature.

Humphreys received numerous international honors, including honorary memberships in the Imperial Royal Geological Institute of Vienna and the Royal Institute of Science and Arts of Lombardy, appointment as a fellow of the American Academy of Arts and Sciences, and an honorary doctorate of laws from Harvard College. In 1866, following an impressive performance during the Civil War in which he advanced to the rank of brevet major general, Humphreys was appointed Chief of Engineers. He served in that capacity until 1879.

Although the formula offered by Humphreys and Abbot was flawed, their conclusions influenced the development of river engineering and the evolution of the Army Corps of Engineers. The authors believed that using levees only could control flooding along the lower Mississippi; neither costly reservoirs nor cutoffs were needed. The Corps of Engineers accepted these conclusions for nearly 60 years, not just for the lower Mississippi

but for other large rivers as well. The "levees only" policy profoundly affected the manner in which the United States developed its water resources. Indeed, the influence of the Humphreys-Abbot report extended past World War II, despite the fact that by then Congress had authorized hundreds of reservoir projects.

CHAPTER V

Expanding Frontiers

Pre–Mexican War Exploration

Exploration by Army officers dated back to the turn of the 19th century, with the expeditions of Meriwether Lewis and William Clark, Zebulon Pike, and others. The first expeditions involving Topographical Engineers came a little later. Stephen Long, who figured prominently in many important endeavors during his long career as a Topographical Engineer, led the first trans-Mississippi parties for the topogs. Between 1817 and 1823, Long ranged far and wide in the West, surveying sites for Fort Smith on the Arkansas River and Fort Snelling up the Mississippi, marking a portion of the border between Minnesota and Canada, and trekking as far west as the Colorado Rockies. For all of his accomplishments in the West, as an explorer Long is remembered mainly for fixing the label "Great Desert" on the high plains. He pronounced the region "almost wholly unfit for cultivation and, of course, uninhabitable by a people depending on agriculture for their subsistence." Others, observing the lack of streams and forests, took the same view, but Long went down in history as the author of the myth.

During the 1820s and 1830s, the federal government focused its efforts on the vast triangle west of the Mississippi, north of the Missouri, and south of Canada. At first, competition with Britain for furs and Indian loyalty drove this effort. Later, the increasing number of settlers in Michigan, Wisconsin, and Minnesota, and rumors of rich metal deposits along Lake Superior, created the demand. Topographical Engineers were few, and the demand for their services farther east coupled with a lack of money for a concerted effort meant that only a few expeditions went into the Northwest. The two most important, led by the French scholar Joseph N. Nicollet in 1838 and 1839, resulted in an excellent map of the hydrographical basin of the upper Mississippi. The expeditions also introduced a young

In 1842 Frémont scaled Snow Peak in the Wind River Mountains and focused national attention on the route to Oregon through South Pass. Fifty years later, he still held the national imagination, as this stamp from the 1893 trans-Mississippi exposition series shows.

topog second lieutenant named John C. Frémont to western exploration.

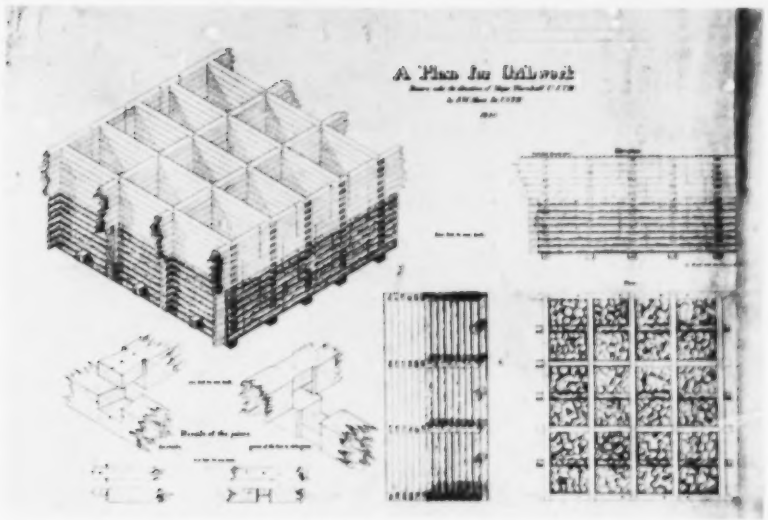
Frémont was the dominant personality in topog exploration during the first half of the 1840s. The nation was poised on the edge of a continental destiny, and the flamboyant "Pathfinder" turned all heads west toward Oregon and California. As much the agent of his father-in-law, expansionist Missouri Senator Thomas Hart Benton, as he was Abert's subordinate, Frémont led three expeditions between 1842 and 1846. The first dramatically publicized the easy South Pass crossing of the Rockies in what is now Wyoming. On the second expedition, Frémont identified the true character of the Great Basin, a vast internal drainage system that he circled on an eight-month 3,500-mile journey. The third expedition, his last for the bureau, put him in Mexican California at the onset of war. Once in California, he became involved in the Bear Flag revolt and the overthrow of Mexican rule. His reports, written with the help of his able wife Jessie, assaulted the notion of a Great American Desert and touted the possibilities of Oregon, California, and the valley of the Great Salt Lake.

Although Frémont grabbed the headlines, others made major contributions. Lieutenant William F. Franklin rode with Stephen Watts Kearny's Sioux expedition in 1845, reconnoitering and mapping parts of present-day Nebraska, Colorado, and Wyoming. When Kearny went south the next year to command a column against Mexico, Lieutenant William H. Emory led a topographical party that mapped Kearny's route across the Southwest to California. He and his assistants also collected specimens of the fauna and flora along the way. Although overshadowed by the charismatic Frémont, the red-whiskered and quick-tempered Emory was a major figure in western exploration before leaving the topogs in the 1850s for faster promotion in the cavalry. While Emory was in California, Lieutenant James W. Abert, the colonel's son, and Lieutenant William G. Peck scouted and mapped the valley of the Rio Grande, from Socoro to Santa Fe.

Western Roads

Behind the explorers came the surveyors and road builders. In the late 1830s, while Nicollet examined the country between the Mississippi and Missouri rivers, the federal military road-building program centered on Michigan and Wisconsin territories to the east. The Topographical Bureau was solely responsible for this program, which included building eight roads in Michigan, seven in Wisconsin, and others in Iowa, Arkansas, and Florida. National defense was cited as a constitutional justification. The road program was tied to military requirements until the Civil War, and most federal roads in the West had at least one terminal at a military post. Nevertheless, the concept was sometimes no more than a convenient fiction. The eight Michigan roads of the territorial period all converged on the center of population at Detroit. Only the road to Fort Gratiot, needed when ice closed the St. Clair River, could truly be justified on a military basis.

The Wisconsin roads constructed under Captain Thomas Cram featured bridges built in accordance with a plan invented and patented by Stephen Long while working on the Baltimore and Ohio Railroad. Long's timber truss bridge claimed two firsts. It was built without an auxiliary arch and was the first to be based on mathematical calculations. It was later superseded by



a design that used vertical iron rods, but Cram successfully used the Long design for all spans over 20 feet long.

Abert's bureau took its road responsibilities seriously. Whenever possible, he assigned an officer to supervise a project; at other times he sent a civilian agent. Whether civilian or military, the superintendent carried out a preliminary survey to determine the best course of action and prepared cost estimates for the desired approach. Bureau review of the proposed course of action preceded the letting of any building contracts, which usually were awarded locally. The officer or agent in charge remained as supervisor and inspector until released from the duty by the War Department.

West of the Mississippi River, roads more often had genuine military purposes. However, they too were also built to ease the westward migration and for mail delivery, commerce, and agriculture. Over time roads constructed by the topogs in Iowa and other prairie states just west of the Mississippi contributed significantly to economic development.

Military Surveys

In the years prior to the Mexican War, the bureau did give some attention to military matters. Abert had learned his lesson from the Seminole War and did not want to be caught short

James Abert, a graduate of Princeton College as well as the Military Academy, was highly regarded by his peers for his drawings. These examples show his ability put to different uses. In 1845 he drew the cribwork plan, opposite page, for the Potomac River project while working in the Topographical Bureau's Washington office. A year later, he was at Bent's Fort preparing for a reconnaissance of New Mexico and drew the Indian portrait. Abert was injured during the Civil War and resigned in 1864. His later activities included spending eight years as a professor of English literature at Missouri State University, an improbable post-service job for an Engineer officer.

again. Now was the time, he wrote in 1842, to finish such work while peace afforded the opportunity to do it right. His topographers conducted surveys for defense purposes at several places, ranging from the harbor at Portsmouth, New Hampshire, to the roads leading to and from Washington, D.C., but the emphasis was on two areas in particular, Florida and New Orleans. Abert called the New Orleans survey, finished in 1842, "extensive and minute." It ranged as far west as the Atchafalaya River, south to the Gulf of Mexico, and east to Cat Island. In Florida, much of the work concentrated on the southern coast. In 1845 Major Bache managed "the extensive survey of a military character which had been required of the shoals, reefs, and harbors at the southern extremity of Florida." The work took in the Florida reef from Cape Florida to the Dry Tortugas, the Dry Tortugas themselves, Key West harbor, Bahia Honda, and Boca Grande. With this effort completed in 1845, Abert turned his attention westward. The annexation of Texas, he knew, would require similar surveys on the coast and frontier of that area.

The Mexican War

When the Mexican War broke out in 1846, Abert's officers were soon too busy for systematic surveys of any kind. Rivers and harbors work was virtually suspended, and the Topographical

Bureau found itself with little to do. For the individual officers it was a different story. Two-thirds of the 36 men of the corps served in the field with various tactical commands during the war, independent of the bureau. Lieutenant Emory and his topographical detachment with Kearny came under fire near San Diego and participated in the Battle of San Pasqual. Captain Joseph Johnston commanded a regiment of mounted infantry and Captain George Hughes became military governor of the area around Jalapa and Perote northwest of Veracruz, with Emory as his lieutenant governor. Frémont played a prominent role in the conquest of California, and Long built steamships for the Quartermaster Department in Texas.

Topogs also played important roles in the major battles along the road to Mexico City. Major Turnbull saw action in all of the clashes between Veracruz and the capital as Major General Winfield Scott's chief topographer. He won two brevet promotions for gallantry in battle. George Meade, who was then still a second lieutenant, scouted enemy positions while under fire at Monterey and pinpointed weaknesses in the defenses of the city. Five topogs were in the thick of the fighting at Buena Vista in February 1847. One of them, Lieutenant Francis T. Bryan, fought with an artillery detachment. He showed no fear. His commander saw Bryan "when exposed to a close and murderous crossfire of grape and canister on one side, and musketry in front, direct the fire of his piece, and give his commands with the same coolness as if he were on parade." At Cerro Gordo, during the same campaign, Lieutenant George H. Derby crept close enough to Mexican positions to estimate the size and composition of the enemy force and artillery and map their locations. During the assault, he was wounded while directing artillery fire.

Two topogs died during the war. In May 1846 Lieutenant Jacob E. Blake was killed when his own pistol accidentally discharged. Four months later, Captain William Williams, General Zachary Taylor's chief topographer, died of wounds received in the Battle of Monterey.

Even in the middle of the campaign for Mexico City, the rivalry between topogs and Engineers flared. Colonel Totten himself commanded the Engineer contingent at Veracruz and made sure his men dominated the topogs. Meade complained to his wife about the situation. "For my individual part," he wrote,

"I have been pretty much a spectator for a week, the Corps of Engineers having performed all the engineering that has to be done. This is attributable to the presence of Colonel Totten, who wishes to make as much capital for his own corps, and give us as little as possible."

Despite Totten's efforts, Colonel Abert still had reason to speak proudly of his officers. The topogs, he said, showed "the versatility of talent in the Corps and its ability to fulfill any military duties which it may be found necessary or proper to assign to it." He was right. As explorers and cartographers, and as naturalists and soldiers, the topogs were as much a part of the Mexican offensive as officers and men of the line.

The Southwestern Reconnaissance

The Mexican War directly spawned two major efforts that involved the topogs in the Southwest: a survey of the new border with Mexico and a survey of the vast territories acquired as a result of the war. Numerous expeditions, with assignments tailored to fit the needs of specific locales, went into the Southwest. Some places required initial exploration; other more settled areas needed roads to connect towns and forts. Elsewhere, topogs located sites for military posts and railroad passes, reconnoitered rivers, and improved harbors. From the Grand Canyon of the Colorado to the Great Salt Lake and from San Antonio to San Diego, the topogs crossed and recrossed the Southwest, examining the new country and binding it to the old.

In Texas, where the great need was for roads, Joseph Johnston, now a lieutenant colonel, supervised the efforts of four topogs and one Engineer. From 1849 to 1851, they overcame a variety of obstacles—from Apache marauders to the dry tableland between the Concho and Pecos rivers—to lay out a system of transportation and communication that tied the forts and towns together. The reconnaissance ended just before the Civil War on an unusual note, with two expeditions under topog Lieutenant William H. Echols using camels as pack animals. The camels proved well suited to the dry country, but were universally disliked for their odor, growl, and bad temper.

The topogs were also busy elsewhere in the newly acquired territory. In New Mexico, Lieutenant James H. Simpson made discoveries of lasting scientific importance. In Chaco Canyon

In the years after the Mexican War, the process of expansion was so rapid that the stages of development overlapped. Lieutenant Derby's map of the San Diego area was produced in conjunction with a harbor improvement project in 1853, just as Lieutenant Williamson began to probe the mountains to the east for a pass that might be suitable for a railroad. Derby's work in San Diego was the first Army Engineer civil works project on the Pacific Coast.

and in Canyon de Chelly, he found some of the most important archaeological sites in the United States: ancient Indian pueblo communities of stone, mortar, and wood. Accounts of the pueblo cultures still begin with references to Simpson's discoveries. Captain Macomb, fresh from 14 years with the Great Lakes Survey, completed several roads through New Mexico in 1856 to 1859. Captain Howard Stansbury and Lieutenant John W. Gunnison picked up where Frémont had left off in the valley of the Great Salt Lake in 1849, and Simpson laid out a shortcut through the basin to California.

In California, Captain William H. Warner examined routes between San Diego and San Francisco before leading an expedition east into the Sierra Nevada with Lieutenant Robert S. Williamson. In September 1849, Warner and a guide were killed in an ambush by Indians. Williamson recovered his notebooks and withdrew to Sacramento to compile a report and map. Meanwhile, Lieutenant Derby started the first rivers and harbors project west of the Mississippi, an attempt to improve the harbor at the mouth of the San Diego River. Topographer Derby was also known as the humorist John Phoenix, a punster who denied requisitioning a lathe with which to turn the river but who admitted having been sent to dam the river "and that he had done it (mentally) several times since his arrival."

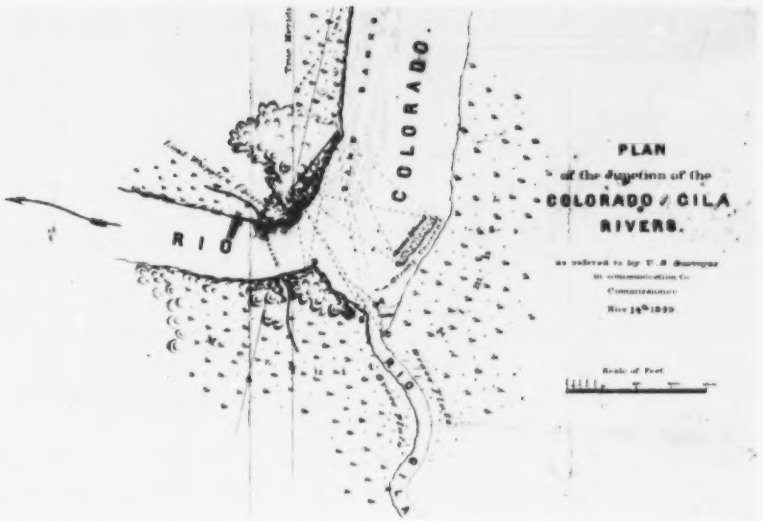
The southwestern reconnaissance ended with a flourish. Lieutenant Joseph C. Ives led a party up the largely unknown Colorado River. The expedition started as an attempt to determine the navigability of the river upstream from the crossing at Fort Yuma. From the head of navigation at Black Canyon, Ives struck out overland. The journey gave him the chance to see what no scientist before him had seen, the vast eroded plateau and gigantic gorges of the Grand Canyon. He also made the first exploration of the canyon floor. Awed though he was by the grandeur of the canyon, Ives was still an engineer who thought in terms of practical applications. For the canyonlands he saw none and so dismissed them as "altogether valueless." He was the first white visitor and expected to "doubtless be the last . . . to visit this profitless locality."

The topog work in the Southwest eased the way for the nation's growth while contributing to a deeper understanding of the natural and human history of the continent. The period was the heyday of the topogs, their busiest and most productive period as explorers.

Boundary Surveys

By the time of the Mexican cession, the Topographical Engineers had ample experience with boundary surveys, dating back to before the formal establishment of the corps. In the 1830s such work involved state borders and the lines between lands ceded to various Indian tribes. Sometimes this latter category produced some anxiety. Captain Washington Hood, who had run the Ohio-Michigan line in 1835, was assigned four years later to mark the borders between several tribes west of the Mississippi, among them the Iowa, Sauk, Kickapoo, and Shawnee. Hood considered the original survey by the Bureau of Indian Affairs to have been less than exact, but advised against an accurate resurvey. "The result of our surveys carried out would," he wrote, "cause a clashing among all the tribes bordering upon the frontiers of Arkansas and Missouri; would create the greatest mass of confusion and discontent—therefore the uncertainty which rests upon my mind as to how I should proceed." Abert did a quick calculation of possible benefits and costs and recommended against the project.

Projects in the 1840s included surveying several state boundaries, the very temporary line separating the United States from



Lieutenant Amiel W. Whipple drew this map during the survey of the boundary with Mexico. The map shows the lines of triangulation from a baseline along the bank of the Colorado opposite the mouth of the Gila. Initially, the Gila was supposed to form part of the boundary between the two countries. After only eight days at this location, Whipple noticed that the river already had erased a long sandy point at its mouth. Hence, it would not serve as a fixed point for the boundary. A major when the Civil War broke out in the spring of 1861, Whipple became a brigadier general of volunteers and commanded a division. He was fatally wounded at Chancellorsville in May 1863.

the Republic of Texas, and the northeastern portion of the border with Canada. The combined field and office work for this effort lasted a decade. James Graham, then still a major, headed the survey team, which was detached from the bureau for the duration and assigned to the State Department. Abert disliked the arrangement and complained that Graham should have continued to work for the bureau, which was accustomed to directing surveys and could best judge their success. An 1848 fire destroyed many of Graham's maps, but because the bureau had taken its normal precautions and stored the notes separately from the final maps he was able to reconstruct them from his original field notes.

The long drawn-out Mexican boundary survey was at least as difficult and complex as any of its predecessors. Political appointees ran the commission, and the Corps of Topographical Engi-

neers provided the professional talent, with Lieutenant Colonel John McClellan, James Graham, and Emory leading the topog contingent at various times. There were problems aplenty. Indian raids, boondogglers, and disputes with the Mexicans over the location of the boundary intended by the Treaty of Guadelupe Hidalgo all complicated the survey. Furthermore, the boundary sometimes moved. Lieutenant Amiel Whipple, at the junction of the Gila and Colorado rivers, noticed that the Gila had eroded away a long sandy point at its mouth in a mere eight days. The river, designated by the treaty as part of the boundary, did not always run in the same bed. This problem remained until the Gadsden Purchase, surveyed by a commission under Emory in 1854 and 1855, established a new and more reliable border.

In addition to determining the boundary, the survey achieved enduring scientific results. The scientists and collectors who accompanied the field parties accumulated a remarkable amount of data and great quantities of natural history specimens. These collectors and their colleagues in the East, who analyzed the data for publication, contributed substantially to scientific knowledge of the borderlands. Some of the greatest men in American science participated in the collection, organization, and publication of the commission's field acquisitions. Louis Agassiz, John Torrey, James Hall, and the Smithsonian's Joseph Henry and Spencer Baird all lent their talents to the enterprise. Emory's report was his last and greatest contribution to geographic knowledge. Thorough, precise, and well illustrated, it faithfully depicted the borderlands. It included accounts of the survey, and field reports on geology, botany, and zoology, together with the findings of the scientists who classified the specimens. The scientific achievement contrasted with the political troubles that dogged the survey.

Post–Mexican War Western Roads

The period following the Mexican War accelerated and complicated the usual process in which road building followed exploration and railroads came later still. After the vast Mexican cession was added to the national domain, all three phases of the process took place simultaneously, sometimes in the same region. Johnston's Texas reconnaissance included expeditions

that combined explorations and road surveys. Pacific Coast communities, more fully developed than some interior areas, were further along in developing transportation systems. So while Ives probed the Grand Canyon, road construction programs were under way in Oregon, Washington, and California as well as in Minnesota, Nebraska, and Kansas. Not only was the process becoming jumbled, but California-bound gold-seekers rushing across the continent demanded a different style of building. Speed rather than comfort became the overriding consideration. The new emigrants were satisfied with just a trace of a road as long as it was adequate for wagons. With this criterion, the shortest route with enough water, wood, and grass was the best.

Just as with rivers and harbors work, Abert set up field offices to handle western roads. The most active were the Office of U.S. Government Roads in St. Paul, Minnesota, and the Office of Military Roads, Pacific Coast, which worked first out of San Francisco and later at Fort Vancouver, Washington. The work in the Pacific Northwest, which centered on an effort to connect the Columbia River to the Missouri, was handled somewhat differently than the Minnesota project, with construction done by employees of the office rather than by contractors.

Congress took the topogs out of the road-building business in 1856. Congressional impatience with the time-consuming military surveys that always preceded actual construction led to the formation of the Pacific Wagon Road Office in the Department of the Interior. Albert H. Campbell, head of the new office, had worked with topog explorers and shared the legislators' dislike for the Army way of road building. He opposed the system of awarding jobs to the lowest bidders, who invariably seemed to run out of money before they finished, forcing Campbell to turn to Congress for more. He believed that in cases where roads had to be built with a single appropriation, a bonded superintendent and an engineer, both with fixed salaries, should hire and supervise their own work crews.

Campbell too had his problems. His civilian engineers did their jobs well enough but his superintendents, who had more political influence than managerial talent, proved inept. Three were convicted of fraud, and overall the office's record was poor; "the gloomiest in the history of federal aid to road building in

Each season held perils for exploring parties. Both illustrations from the report of the Pacific railroad survey led by Isaac Stevens show members of the expedition crossing the Hellgate River. In the case above, they braved winter ice; in the other, spring runoff.

the trans-Mississippi West," according to historian W. Turrentine Jackson.[1]

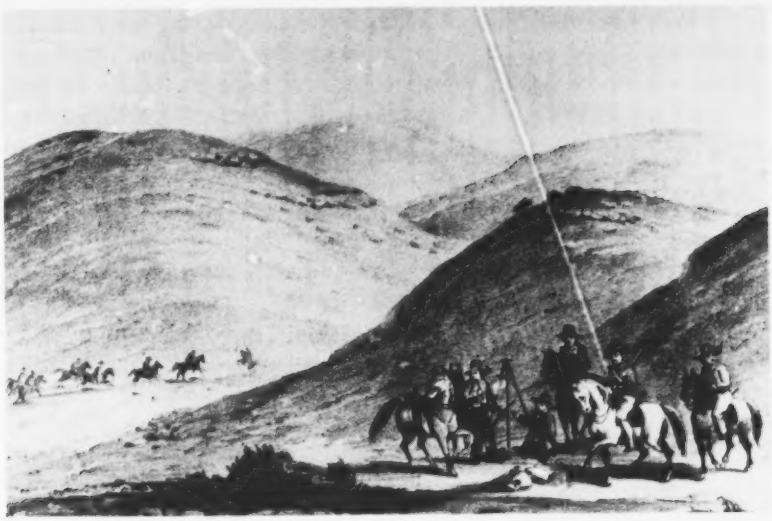
By the time that the Interior Department took over the road-building program, the topogs had made their mark. All told, they built 34 trans-Mississippi roads in the 1850s at a cost of over $1 million. In Minnesota, New Mexico, and elsewhere, Topographical Engineer surveys determined the basic pattern for the modern highway network. Many railroads also followed their routes.

Pacific Railroad Surveys

Work on the Mexican boundary was still in progress when the Pacific railroad surveys got under way. The topogs had ample experience with railroad routes by the 1850s. Late in the 1820s, Stephen Long had surveyed the first railroad line in the country, the Baltimore and Ohio from Baltimore to Ellicott City, Maryland. Closer to the starting point of the trans-Mississippi lines, topogs had done the preliminary survey for a railroad from Milwaukee to the Father of Waters. In addition, the surveys represented a logical step in the development of the national transportation routes. Officers involved in the enterprise understood the progressive relationship between exploration, wagon-road surveys, and railroad work. Instead of being an innovation, the surveys represented an acceleration of the federal effort to improve these routes.

While the surveys did represent a logical next step, the politics of the situation set them apart. Essentially, the Pacific railroad expeditions were an attempt to impose an engineering solution on a political problem. The law requiring the surveys included no suggestion of the political basis. The act of 3 March 1853 blandly authorized Secretary of War Davis to use part of the Corps of Topographical Engineers "to make such explorations and surveys as he may deem advisable, to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean"; provided $150,000; and required a report to Congress by February 1854. But the reason for the survey was plain. Congress, beset by many conflicting

[1] W. Turrentine Jackson, *Wagon Roads West: A Study of Federal Road Surveys and Construction in the Trans-Mississippi West, 1846–1869* (Berkeley: University of California Press, 1952), p. 325.



This drawing of a party of Lieutenant Williamson's Pacific railroad survey at work in Livermore Pass appeared in Williamson's report.

interests, could not settle on one best transcontinental route. So the legislature directed the Topographical Engineers to reconnoiter several potential lines, burdening Davis with the choice of the best route based on data compiled by field parties. Presumably, the topogs' impartial analysis would succeed where partisan politics had failed.

Bypassing the Topographical Bureau, Davis set up a new agency, the Office of Pacific Railroad Explorations and Surveys, to administer the program. Major Emory directed the office, which was charged with assessing the data generated by the surveys. When he left in 1854 to survey the Gadsden Purchase line, Captain Humphreys took over. This was a complex assignment: each expedition was to report on the many determinants of railroad construction, among them distances, grades, mountain passes, canyons, bridge sites, and tunnels. Each survey also had to consider natural resources, particularly timber, stone, coal, and water, all of them important for building and operating a railroad. With a number of scientists, including geologists, mineralogists, and naturalists accompanying each party and participating in the inquiry, the surveys provided an outstanding opportunity for science to influence national policy.

Of many possible routes, four that had substantial congressional backing were chosen for scrutiny. The northernmost survey was the only one not led by a Topographical Engineer. Former Engineer officer Isaac I. Stevens, on his way west as the newly appointed governor of Washington Territory, examined a route between the 47th and 49th parallels from St. Paul, Minnesota, to Puget Sound. Topog Captain John Gunnison led a party over the central route that started along the 38th parallel by way of the headwaters of the Arkansas to the Great Salt Lake, then shifted north along the 41st parallel. Gunnison was killed by Indians in an ambush near Sevier Lake in Utah and artillery Lieutenant Edward G. Beckwith, who commanded the escort, finished the survey. Farther south, Lieutenant Whipple commanded the 35th parallel survey from Fort Smith, Arkansas, to California via Albuquerque. The southernmost route along the 32d parallel, through Texas and the Gadsden Purchase, was surveyed by two expeditions, one under Lieutenant John Pope and another under Lieutenant John G. Parke. Other parties under Parke, Abbot, and Williamson probed the mountains of Oregon and California for railroad passes.

Captain Humphreys, assisted by Lieutenants Abbot and Gouverneur K. Warren, evaluated the data and prepared cost estimates based on distances, terrain, and the experiences of railroad builders east of the Mississippi. Calculations showed that all of the proposed lines would be tremendously costly. The least expensive 32d parallel route would cost about $69 million, which equaled the entire federal budget for 1856. Moreover, there was no clear-cut best choice from an engineering standpoint. The other three routes seemed practicable albeit more expensive. Indeed, after the Civil War, transcontinental lines were built on or near all four routes. For the time, Congress remained deadlocked. Critics attacked the cost estimates produced by the surveys from both sides; for either inflating or understating the cost. Some claimed the 32d parallel route, so near the border and therefore vulnerable to disruption in a war, was absurd. So the surveys, designed to clarify the issue, only clouded it.

As a scientific enterprise, on the other hand, the project had remarkable and enduring results. The field parties amassed a vast quantity of specimens and scientific data. With the help of scholars in eastern cities, the accumulation provided a compre-

hensive record of trans-Mississippi fauna and flora, geological structure, and geographical features. The 13-volume final report immediately became famous. The huge compendium was widely discussed in the daily press, in popular magazines, and in the streets and homes of America. The report is still well known to naturalists. As A. Hunter Dupree concluded in his study of the federal government and science, "to the student of the fauna, flora, and geology of the West, the volumes still seem as live and as important as they seem futile to the political historian."[2]

Lieutenant Warren's map of the trans-Mississippi West ranked high among the accomplishments of the survey. The completion of this cartographic milestone marked the close of an era for the topogs. A few voids remained. The little-known parts of the West still to be charted included the Nebraska sandhills and the upper reaches of the Yellowstone River. Nevertheless, an essential task had been completed. For nearly 40 years, since Long's trek to the Rockies in 1819, topogs had charted portions of the vast West. In 1858 the basic contours of the enormous region were at last understood and a general map was readily available.

The Isthmian Canal Route

The Isthmus of Darien in Colombia was far removed from the scene of the Pacific railroad surveys. However, when Congress authorized a survey of a canal route across latter-day Panama, a topog became involved there as well. Indeed, despite the remoteness of the site, the purpose was similar to that of the surveys across the United States. All of them sought ways to connect the new western portions of the country, especially the Pacific Coast, with the older East.

The canal project was a joint enterprise, under overall management of the Navy Department, to which topog Lieutenant Nathaniel Michler was detached. He was assigned to do the topographical surveys of land and river sections of a route across the isthmus via the Atrato and Truando rivers. Navy Lieutenant Tunis Craven did the hydrographical examinations of the harbors at each end.

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[2] A. Hunter Dupree, *Science in the Federal Government, A History of Policies and Activities to 1940* (Cambridge: Harvard University Press, 1957), p. 95.

During 1855–1857, Lieutenant Warren went on three expeditions to the northern plains. The latter two, under his command, filled blanks in the map he was compiling for the Pacific railroad surveys. But the first, for which he did this route reconnaissance from Fort Pierre to Fort Kearny, was a punitive expedition against the Sioux. Warren's notation on the bottom left of the map shows the kinds of questions Topographical Engineers asked about the routes they examined: "Route has generally plenty of water & fuel & grass, is not practicable for loaded wagons. But good for pack trains or droves of cattle."

The party set sail from New York in December 1857 and spent much of the next year carrying out the mission. In the tradition of Frémont, Michler wrote a vivid, and at times even dazzling, account of his experiences amid the exotic fauna and flora of Panama. He ran out of money after returning, but Abert managed to convince Congress to provide additional funds so he could complete his map. Sandwiched between Michler's more prosaic assignments, surveying a road westward from Arkansas and running the Maryland-Virginia border, his survey marked the first involvement of Army Engineers in considering an isthmian canal project.

CHAPTER VI

Decline and Demise

Decline of the Bureau

The 1850s were a difficult period for Colonel Abert. The decade started with him complaining about inadequate manpower. The Coast Survey wanted more of his officers, and he could spare none In 1855, asking for 24 additional captains and lieutenants, he found himself again forced to employ civilians and line officers to compensate for his small numbers. These temporary assistants were inefficient, their experience departed with them, and they were costly. In 1856 Abert used three pages of his report to list by name the assignment and location of each officer, noting their assignments "from the Atlantic to the Pacific; from Lake Superior to the capes of Florida" and their duties "as various and diversified as . . . the objects over which the general government exercises a control." Many were overworked, he said, with "an amount of responsibility and control which might with advantage be lessened, did the number constituting the corps admit it." With that, he renewed his request for more officers.

He never stopped. In 1858 he compared the size of the United States when his corps was formed to that of the nation at mid-century. His officers now had duties extending to the Pacific Coast, with responsibilities for explorations and surveys, military roads, and service with military departments "west of the frontier of the old States of the Union." Therefore, he wrote, "an increase of the corps is absolutely necessary to meet the demands of the government for its services, and the recommendation made in previous reports is now renewed." He also wanted more money for instruments and a printing plant so the bureau could produce its own maps.

Abert did have a program in mind for an expanded corps. In 1856 he called the region west of the tier of territories from Arkansas north to Wisconsin and east of California "compar-

atively unknown" with parts "absolutely as unexplored as is the interior of Africa." Much of this unknown new country resembled "a wedge into the heart of our country." Anticipating the great surveys of the 1870s, he wanted to cover the entire western interior with "a net-work of explorations and surveys, accompanied by a series of carefully conducted observations of every kind that will fix its geographical, mineral, vegetable, and climatic peculiarities." "Thus," he claimed, "would every stream and mountain become known, and every nook, valley and plain be open for the settlement and enterprise of our population."

While he strove earnestly to convince Congress to provide the resources that would accommodate his vision, he watched his mission slip away. First came the reintroduction of the Corps of Engineers into rivers and harbors work in 1852. Then came the worst blow. Secretary Davis took the Pacific railroad surveys from Abert's control and placed them under a new office that reported directly to Davis. This action marked the end of the bureau's involvement in western exploration. A third reduction came when an impatient Congress assigned the western roads to the Interior Department. Moreover, although Lieutenant Warren's map of the trans-Mississippi West did leave some blanks, it nevertheless provided an accurate overall picture of the region. The great reconnaissance of the West was essentially over.

Indeed, Abert struggled against the tide. Ever since the Mexican War, individual topogs had distinguished themselves while the bureau sank into obscurity. Frémont had ignored his orders and carried artillery to California, where he became a hero and later a presidential candidate. Then Emory gained renown in southwestern natural history while working for the boundary commission. Warren produced his map for the Office of Pacific Railroad Explorations and Surveys. Even Michler's work in Panama was for the Navy. The dominant theme of the post–Mexican War years was the rise to prominence of many topog officers while the bureau declined. Abert, who reached his 70th birthday and his 44th year of military service in 1858, may not have recognized the direction in which these developments pointed.

The Civil War

The Civil War succeeded where a decade of Abert's lobbying had failed. In two separate acts passed in August 1861, Congress

Civil War topographers, shown at Camp Winfield Scott, near Yorktown, Virginia, in May 1862.

made modest increases in the size of the corps. The numbers still fell short of Abert's hopes, but two increments of 6 brought the authorized strength to 48. Abert stayed on active service just long enough to see this expansion take place and then retired. Stephen Long, who at 76 was four years older than Abert, replaced him. Other longtime topogs, including James Kearney and Howard Stansbury, also retired in the opening months of the war. A few, among them Johnston and Ives, went south and joined the Confederacy.

The corps actually hit a peak strength of 45 in 1861 but dropped off to 28 the following year. The decline was due to the assignment of topogs to responsibilities outside the bureau. By that time, Humphreys, Warren, Pope, Whipple, and numerous others were senior staff officers on the way to general officer rank and major commands or had become generals already.

The bureau itself, once the administrator of large-scale civil works and exploration projects, reverted to duties reminiscent of the days of Roberdeau, printing and ditributing maps for use in the field. This was an important mission, and the bureau could never keep up with the demands of field units, which had their own topographical departments to suplement efforts in Wash-

Andrew A. Humphreys (1810–1883) as a major general during the Civil War. Humphreys was Chief of Engineers from 1866 to 1879. He was a fun-loving youth, and his standing at West Point, where he graduated thirteenth in a class of 39, resulted from the numerous demerits he received for his pranks rather than from want of academic talent. He showed a composure and self-confidence that rarely deserted him. Humphreys fought in the Seminole War in Florida in the 1830s but became sick with fever and shortly thereafter resigned, only to join the newly established Corps of Topographical Engineers in 1838. He worked on numerous projects, mainly in the Washington, D.C., area. From 1844 to 1850, Humphreys was de-

ington. The most sophisticated of these field offices was the Army of the Potomac's Office for Surveys for Military Defenses, later the Office for Surveys and Maps and headed by topog John Macomb. This office did its own research, field work, printing, and distribution.

Civil War Troops

In his efforts to gain more people and money, Abert did not forget the need for Topographical Engineer troops. In its entire existence up to the Civil War, the Corps of Topographical Engineers always consisted exclusively of officers. As late as November 1860 Abert was still asking for a "company of pioneers" to assist with military and geographic exploration. The Corps of Engineers, on the other hand, had added a company of engineer soldiers at the start of the Mexican War. This company formed the basis for expansion and creation of other regular army engineer units during the Civil War. But no such unit served the topogs.

Topographical officers knew how useful such troops could be. In 1845 Major Graham did have enlisted help on the northeastern boundary survey. A detachment of ten men from the 2d Artillery Regiment, "selected," Graham said, "with a due regard to intelligence and moral character," assisted astronomical

tailed to the U.S. Coast Survey. In the last year, he was assigned to work with Stephen Long on the Mississippi Delta Survey, a project that brought him a worldwide reputation. Aside from a year and a half of travel and study in Europe and approximately two years directing the Pacific railroad surveys, most of his work during the 1850s was with the delta survey. His 500-page report, coauthored by Lieutenant Henry L. Abbot, arrived at the office of the Chief of Topographical Engineers in August 1861, a few months after the firing on Fort Sumter. During the Civil War, Humphreys rose to the rank of brevet major general and became a corps commander. He earned a reputation as a fearless leader and, occasionally, a peerless swearer. He saw action in numerous battles, including Fredericksburg, Chancellorsville, Gettysburg, Cold Harbor, and Petersburg.

observers by noting the time on chronometers and recording observations as announced. They also prepared catalogs of stars, found logarithms for computations, and performed some elementary computations. In addition, they transported apparatus, ran experimental lines with compasses, plotted field work of preliminary surveys, and served as chain bearers and instrument carriers. Graham appreciated these services. "It would," he said, "add greatly to the practical usefulness of the corps, and also tend to economy, if instead of these details, which are liable to change, and consequently a loss to the service of the experience and practical efficiency previously acquired, a certain number of non-commissioned officers and men could be permanently attached to the corps by regular enlistment." Even as few as 12 sergeants, 12 corporals, and 100 privates would permit the assignment of small detachments to each separate command charged with an important operation in the field. Such an organization would cost the government less money than "the usual expedient" of short-term seasonal hires. Abert started to seek such a unit during the same year.

One of the laws of August 1861 that added a small number of officers to the topogs also established a company of soldiers for the corps. Recruiting efforts got under way quickly but were ineffective. The corps lacked a central depot, an officer for instruction,

William H. Emory, left, and Gouverneur K. Warren. Emory and Warren, former topogs shown as Civil War major generals, had been explorers and cartographers. As mapmakers in the 1850s, they had competed with each other. Emory, in the office of the Mexican boundary survey, and Warren, with the Pacific railroad surveys, had raced to be the first to publish an overall map of the trans-Mississippi West. Emory beat Warren into print, but Warren's map was the more comprehensive of the two.

and experienced sergeants. It also had to compete with volunteer units, which tended to get all of their soldiers from the same locale. In two months, the topogs won three recruits. Colonel Long closed down the office and turned the enlistees over to the Corps of Engineers. The topogs never did field a company.

End of an Era

Midway through the Civil War, Congress abolished the Corps of Topographical Engineers as a distinct branch of the Army and merged it into the Corps of Engineers. The same law made the commander of the enlarged Corps of Engineers, still Joseph Totten, a brigadier general. By that time, experience showed that the duties performed by officers of the two corps overlapped and were often the same. So there seemed no need for two organizations, particularly after the Corps of Engineers had taken on much of the civil works mission in 1862. In addition, the bureau's unique role as the federal civil engineering agency

George G. Meade was another former topog who became a major general during the Civil War. Meade graduated from the Military Academy in 1835 but served only one year as an artillery officer before resigning. He rejoined the Army in 1842 as a Topographical Engineer and spent nine years as a second lieutenant. However, within 12 years of his first promotion, he was a major general, in command of the Army of the Potomac and facing General Robert E. Lee's army at Gettysburg. When that critical battle opened, Meade had been in command less than a week. Meade remained in command of the Army of the Potomac for the rest of the war, but Gettysburg remained the high point of his career.

was slipping away with the establishment of other scientific agencies, among them the Naval Observatory, the Smithsonian Institution, the office of the U.S. Coast Survey, and the Interior Department's Pacific Wagon Road Office.

Just before the Corps of Topographical Engineers was established, Secretary of War Joel Poinsett had argued that the "duties of this corps require the combined knowledge of the military and civil Engineers." He had proved correct. The topogs' military duties included surveys for frontier defenses and fortifications and reconnaissances for armies in the field. Their civil duties ranged from railroad and coastal surveys to rivers and harbors work. With the exception of the Mexican War and the Civil War, military duty was always secondary to the civil and scientific work, and most of their military duty was carried out under some authority other than that of the bureau.

In executing a wide variety of duties, the Topographical Engineers contributed significantly to the concept of the modern professional soldier. They believed they were servants of the state and looked to Congress and the Secretary of War for guidelines and policies. The power of the Topographical Engineers rested in their professional engineering expertise. This power was substantial in a period when Army Engineers had a virtual monopoly on the engineering skills so desperately needed by the developing nation. Today, of course, such expertise is shared with private and public engineers around the country.

To the 20th-century Corps of Engineers, the topogs left an important legacy. The pre–Civil War Corps of Engineers resembled a traditional military engineering organization, committed to its work on fortifications, frequently indifferent to involvement in civil works, and a little disdainful of the topogs. The Topographical Engineers, on the other hand, not only accepted new missions but actively sought them. They worked for other government agencies, whether surveying boundaries for the State Department or building lighthouses for the Treasury. They pioneered Engineer work in the District of Columbia. Most important, they combined military and civil functions, moving from one to the other as the situation and government policy demanded. The Corps of Topographical Engineers bequeathed a willing spirit, open to possibilities and eager to try new tasks, to its successors in the modern Corps of Engineers. Not always prevalent and sometimes even dormant, this spirit nevertheless remains an important part of the Corps of Engineers' culture.

To the country, the topogs left a more concrete legacy in an improved navigation and transportation system. Their work helped open markets and increase industrial output. It accelerated the movement of people to the West and changed for all time the distribution of population in the country. That all this was done by an organization of only three dozen or so officers is impressive enough. But perhaps in the end the most important accomplishment of this unique organization was its contribution to a vision of an expanding nation where man would dominate all that he surveyed.

Suggestions for Further Reading

A number of worthwhile books and studies deal in detail with different aspects of the roles and missions of the Corps of Topographical Engineers. Forest G. Hill's *Roads, Rails & Waterways: The Army Engineers and Early Transportation* covers the topogs' work on the nation's waterways. W. Turrentine Jackson, in his *Wagon Roads West: A Study of Federal Road Surveys and Construction in the Trans-Mississippi West, 1846–1869*, describes their role in establishing a national network of roads. For a full treatment of the topogs' role in westward expansion, the reader should see William H. Goetzmann's *Army Exploration in the American West, 1803–1863.*

Some unpublished manuscripts are also especially useful. Garry D. Ryan's dissertation, "War Department Topographical Bureau, 1831–1863: An Administrative History" (American University, 1968), deals with the administrative evolution of the corps and the Topographical Bureau. Adrian G. Traas's master's thesis, "The U.S. Army Topographical Engineers in the Mexican War" (Texas A&M University, 1971), clarifies the roles of individual members of the corps in the various campaigns of the Mexican War.

Some aspects of the topogs' work have never received full treatment. Of the numerous books on lighthouses, none treat the topographers in any detail. The same is true regarding their work in Washington, D.C.

The best sources of information on the overall activities of the corps and bureau, laid out by year, are the annual reports of Colonel Abert. Because Abert used these reports to enumerate the many duties of his officers and to lobby Congress for additional funds and manpower, the reports provide a full record of his operations and problems.

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